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THE NATIONAL GEOGRAPHIC MAGAZINE

Appalachian Valley Pilgrimage

By Catherine Bell Palmer

Illustrations by National Geographic Photographer Justin Locke

LIKE a gigantic furrow, the Great Appalachian Valley plows deep into the face of the United States, creating a continuous corridor from New York to Alabama. Between Carlisle, Pennsylvania, and Natural Bridge, Virginia, lie three sections of this Nature-chiseled pathway—the Cumberland, Hagerstown, and Shenandoah Valleys.

The day I entered the Valley, a brisk autumn breeze was wafting the cidery tang of apples. Nature blended flaming red-gold, deep purple, and brilliant yellow upon the Valley canvas. The green countryside was touched with reddish-yellow of ripening peaches and apples hanging heavy on bending branches. It was a land of beauty and of peace.

Less than a century ago the quiet of this scene was shattered by cannons' roar and shrieking shells as armies of the Blue and Gray locked in struggle.

There is much more in the Valley now than apples, pastoral scenes, and Civil War battlefield sites. From its factories, airplanes and air-conditioning units, plastics and pipe organs, rayon and rubber heels, bricks, furniture, and textiles carry this area's industrial stamp over land and sea.

A Land of Native Americans

Throughout its mountain-bordered length of some 250 miles this Valley area contains more than 600 diversified industrial plants. Scarcely larger in area than Connecticut, its 13 counties shelter nearly half a million people, of whom 92 percent are native Americans.

Early settlers in the Valley wilderness built homes first, churches and schools second, and roads third. Where east-west and north-south roads came together, towns sprang up; today they are found every few miles along the famous Valley Pike (U. S. 11).

But Valley people think counties rather than towns, with the local pride found in English counties.

In Cumberland Valley three towns on the Pike are spaced 10 miles apart, Shippensburg, Chambersburg, and Greencastle. I asked a local historian why.

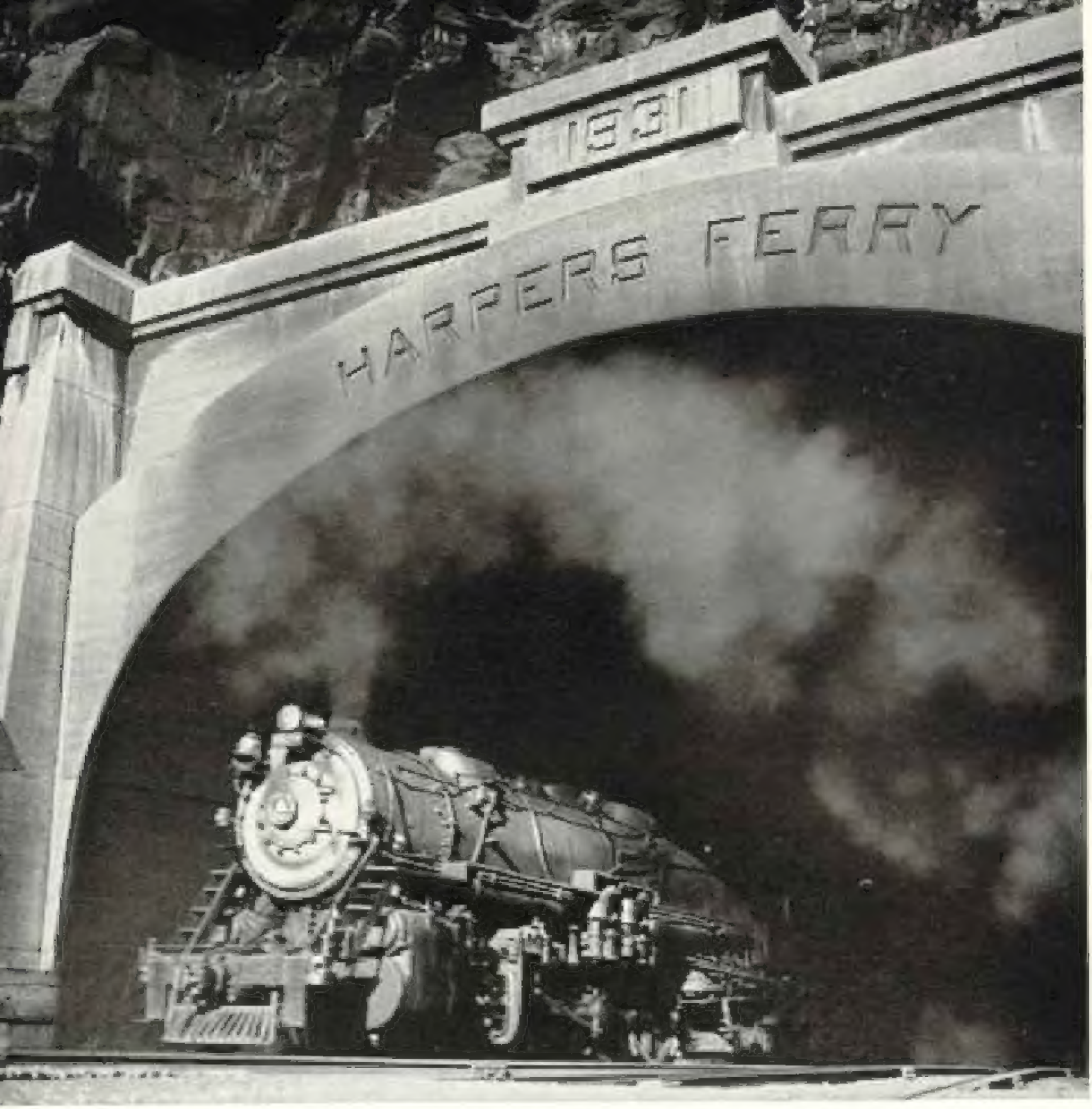
"Churchgoing Scotch-Irish settlers spaced them that way so that folks living between the towns could get to church on time," he told me. "Travel was so slow in those days a man couldn't get to a morning service if he had to go more than five miles."

Today you can hop in your car after breakfast at Carlisle and be in Pittsburgh for lunch. The 160-mile Pennsylvania Turnpike brings industrial Pittsburgh within four driving hours of the State capital, Harrisburg.

Most Cumberland Valley towns have a public square. Wide, shady streets radiate four ways from the square in Carlisle, seat of Cumberland County. Today a traffic light regulates automobiles and pedestrians crossing the square where, in the autumn of 1753, feather-crested Indians talked over peace terms with Benjamin Franklin.

On the northwest corner stands the First Presbyterian Church. Here, in 1774, indignant citizens met to protest the closing of the Port of Boston. George Washington, who was in Carlisle to quell the Whisky Insurrection of 1794, worshiped in this church.

At the Battle of Monmouth, New Jersey, Carlisle's Mary Hays carried water in a



A Baltimore & Ohio Train Puffs Through Elk Ridge Toward Harpers Ferry

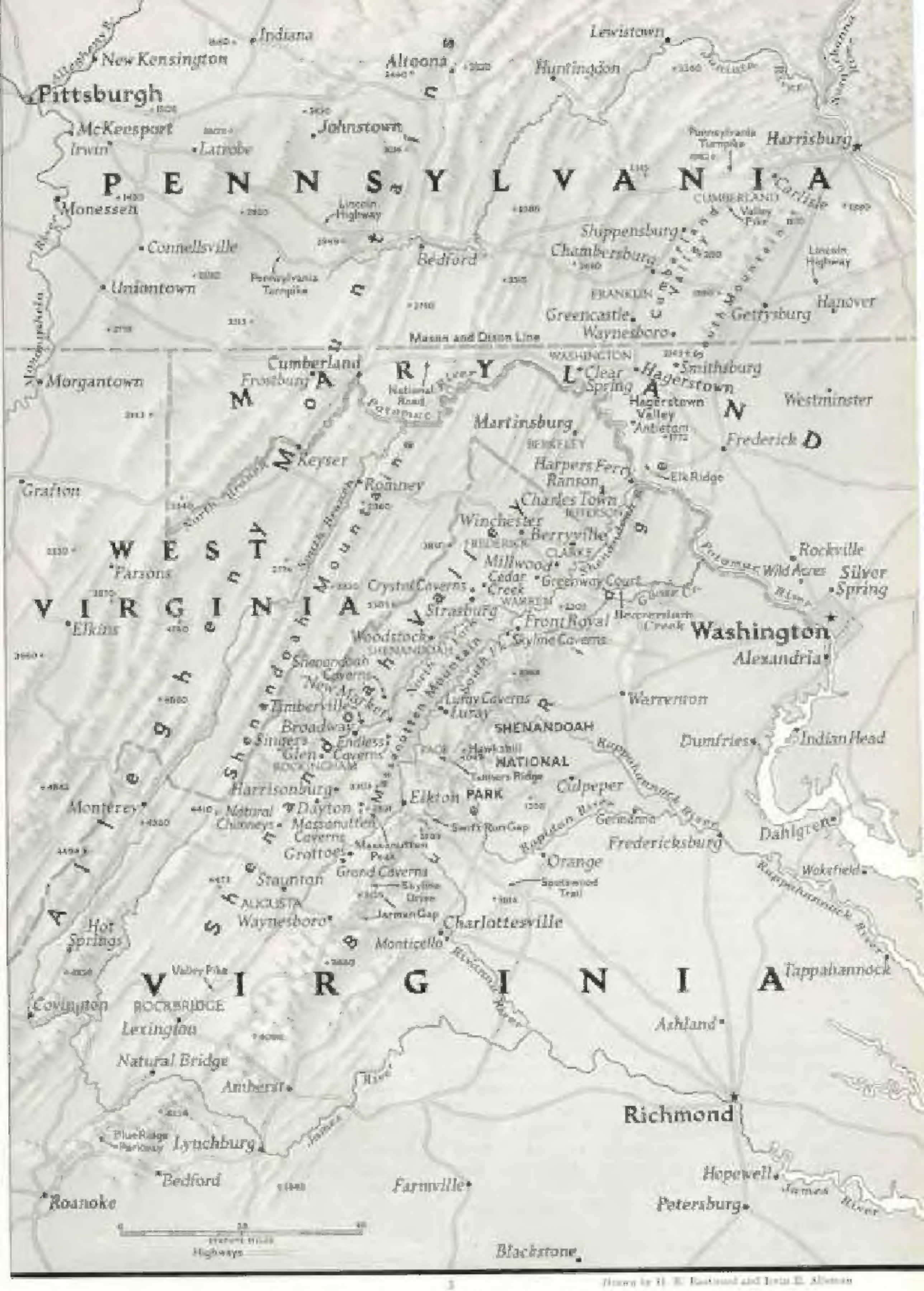
For years the Chesapeake and Ohio Canal Company fought the B & O in the courts for the right of way to Harpers Ferry. When a compromise was reached, both squeezed around the narrow strip of land between the base of the mountain and the Potomac River. Explosives powerful enough to blast the hard rock were not available until 1894, when the railroad tunneled through the ridge. The inscription, "1931," marks the date the railroad widened the west end of the tunnel.

pitcher to wounded soldiers, "Molly Pitcher," they called her, and by that nickname she is known in American history. A few blocks from the Molly Pitcher Hotel a life-size statue marks her grave in the old cemetery.

As a builder of famous athletes, the Indian School at Carlisle Barracks brought fame to the town; such names as Coach Glenn "Pop" Warner and Jim Thorpe became tradition.

Until 1936, tracks of the Cumberland Valley Railroad, now part of the Pennsylvania, ran through the center of town. The first "sleeping car" rolled over the tracks of this railroad in the winter of 1837-38. Crude predecessor of present-day luxurious sleepers, the car was a remodeled day coach, divided into four compartments with three-layer bunks.

Pushing westward from Lancaster and York came the Valley's first white settlers, German and Scotch-Irish, the name America gave to the Scots and English who emigrated to Ulster in the 17th century. Mennonites, Dunkards, Lutherans, and Presbyterians, persecuted in their mother countries, came armed with plow, rifle, and Bible, asking only for land to grow their crops and freedom to worship. Between



Mountain Ridges Shelter Great Appalachian Valley, Pioneer Trail to the West

"What Am I Bid?" Asks Curbstone Auctioneer, Selling Land at Greencastle

Saturday sidewalk sales of estates and stock certificates take place in several Cumberland Valley, Pennsylvania, towns. As the chanting auctioneer walks up and down the street, small children follow in his wake as at a circus parade, and indignant elderly ladies sometimes dispute his right of way. Here an attorney (gray suit, left) is selling four estates totaling 485 acres.

the mountain ramparts they found the land rich enough and spacious enough for all.*

Here Erosion Was a Boon

The Valley is a product of erosion. In the Paleozoic era waters from the Gulf of Mexico and from the Atlantic surged in to blanket the land from New York to Alabama with a huge mountain-locked sea. Some deep-down force caused upheavals in earth's surface, folding rocks back upon one another as if they were dough and sluicing the waters from the upheaving land toward the sea.

Streams which rose in the northwestern mountain ranges flowed southeastward. But when the limestones and shales beneath the Valley floor eroded faster than the resistant sandstone and quartzite rocks of the Blue Ridge, the weaker streams couldn't make the grade of the steep mountain wall. Stronger streams, cutting through the soft Valley limestone more rapidly than smaller streams, diverted them from their southeastward course and became swift rivers.

Chambersburg is the seat of Franklin County. At Memorial Square the Valley Pike crosses the Lincoln Highway, natural route for westward migration of frontier settlers.

On the northern outskirts the smell of apples led me to the H. J. Heinz Company factory. Canning applesauce for babies, first food-processing industry to provide all-year-round employment to the town, was started by Heinz

* See "Penn's Land of Modern Miracles," by John Oliver La Gorce, National Geographic Magazine, July, 1935.

A Cabinetmaker Creates a Chippendale Reproduction at Harrisonburg, Virginia

Wakefield, George Washington's reconstructed birthplace, is partly furnished with Virginia Craftsmen's reproductions of antiques. The business, started in 1977, employs about 40 men. James Metts, who sands the chair, has worked here 19 years.

in 1944. I watched machines core apples, strip off their red and yellow coats, and pass them on to be cooked and strained. The whole process from apples to applesauce takes six minutes!

"On a peak day," a company official said, "we convert some 4,000 bushels of apples into strained applesauce for babies."

Driving along King Street, I paused opposite an innocent-looking little gray frame house. Here abolitionist John Brown and his men met before the raid on Harpers Ferry.

Stocks Sold on the Street

Mountain-girt Waynesboro, Pennsylvania, has a fresh-scrubbed, clean-swept look about it. Driving down its incredibly wide Main Street, I noticed that even the parking meters lining the wide sidewalks sparkled under the shining sun.

A visitor to the town may be startled to hear the chant of an auctioneer and see a crowd around him on the sidewalk. No ordinary auction, this is Waynesboro's custom of making literal use of the term "curb exchange," by selling stocks in its industries and banks at public auction on the street.

South of Waynesboro, where Charles Mason and Jeremiah Dixon drew the line between Pennsylvania and Maryland, the Great Valley takes its local name from the city of Hagerstown, seat of Washington County.

Third largest city in Maryland, according to the Census Bureau, Hagerstown lies at the crossroads of the north-south Valley Pike and the old National Road (U. S. 40) linking east and west.*

* See "A Maryland Pilgrimage," by Gilbert Grosvenor, NATIONAL GEOGRAPHIC, February, 1927.

VMI Cadets Meet Their Dates Beneath a Statue to Stonewall Jackson: Lexington, Virginia

Virginia Military Institute graduates may be commissioned directly into the Army. They have fought in every conflict since the Mexican War. More than 4,000 served in World War II. General of the Army George C. Marshall took his degree here. General Jackson was the Institute's philosophy professor and artillery instructor. Freshmen generally salute as they pass his statue (page 24).

The afternoon I arrived, Hagerstown was busy dressing itself for the first Mummers' Parade since World War II. Bordering the public square, business buildings of 19th-century design, mingling with modern chrome-trimmed shops, were bunting-bedecked. Narrow side streets, with stocky stone houses built by early German inhabitants, were roped off.

Geography of Pipe Organs

Hagerstown's trademark, Gruber's *Almanack*, now 152 years old, forecast for October 31 "fair and pleasant."

Hagerstown's industries, many locally owned, are widely diversified—from dust-control equipment to pipe organs.

The M. P. Möller pipe organ factory has produced more than 8,000 organs. The hand-carved grilles and exterior woodwork of pipe organs are fashioned in Möller's cabinet shops from Appalachian maple and walnut, West Virginia spruce, California pine, Gulf coast cypress, Canadian birch, Honduras mahogany. The many valves admitting air to pipes are made from lambskins imported from England; shellac used on wind chests is supplied by gum from India; manual keys are of African ivory and South American ebony.

National Geographic Photographer J. Baylor Roberts

Technicians Test Streptomycin's Strength and Sterility at Elkton, Virginia

A new antibiotic, streptomycin combats infections such as tularemia, septicemia, and certain types of tuberculosis. In 1946 it cost about $25 a gram. Now the wholesale price is down to 64 cents. At Merck & Company's plant, an operator (right) pipettes culture medium into dishes. Her companion makes sure it is distributed evenly.

Beloved by all Hagerstown residents is "Little Heiskell," the Hessian soldier weather vane atop the City Hall. Fashioned from wrought iron with hammer and chisel by a Hessian tinsmith, Little Heiskell stood guard over the city from 1769 until a Civil War bullet found its way to his heart. Today he has a place of honor in the City Hall's museum, and astride the steeple of the new City Hall is a replica.

Southward through Maryland, Hagerstown Valley is guarded on the east by South Mountain, long linked with legends of mountain folk, descendants of German settlers. Now the older generation of mountaineers has died and younger people for the most part have not retained the folklore and magic cures.

South Mountain's magic cure for dropsy: take three pints of vinegar, one ounce juniper berries, one ounce squills, one gill mustard seed, one handful parsley root, two handfuls horse-radish root. Mix together and boil in an iron pot. Take a wineglassful three times a day before each meal.

Shenandoah, Ancient River Pirate

Eons ago the Shenandoah sector of the Valley was a limestone plateau level with the Blue Ridge. Streams rising in the Alleghenies flowed southeastward across the Valley to Chesapeake Bay. When the soft limestone bed eroded more rapidly than the hard rocks of the Blue Ridge, the buccaneer Shenandoah River seized the chance to "pirate" the waters of Beaverdam and Goose Creeks, and of Rappahannock, Rapidan, and Rivanna Rivers. And today "wind gaps" through the Blue Ridge are monuments to the Shenandoah's piracy.*

Harpers Ferry starts at the top of a mountain, coasts down the steep side of it, and stops abruptly where the Shenandoah River meets the Potomac. I climbed the mountain for a look at the view that Thomas Jefferson said was worth a voyage across the Atlantic. Below, the buccaneer Shenandoah poured its liquid wealth into the rushing, roaring Potomac.† Stronger than other ancient transverse Valley rivers, the Potomac cuts a deep gorge into the Blue Ridge.

When I was a child my parents took me to Harpers Ferry (page 2). There a guide had told me that I was standing in two States with my hand on a third. I think, now, he must have been pulling my leg—it would have had to be longer than it was to stretch across the Shenandoah! But it is true that West Virginia, at Harpers Ferry, does stick out its tongue at Maryland and Virginia.

Sandwiched between the Virginia and Maryland State lines, the West Virginia counties of Jefferson and Berkeley are separated from the rest of the State by the Allegheny Mountains. Now a part of the Eastern Panhandle section of West Virginia, these counties formerly belonged to Virginia.

At Charles Town, seat of Jefferson County, the courthouse where John Brown was tried and convicted for treason is still in use.‡

Somnolent Charles Town wakes up twice a year when horse-racing fans pour in to visit the race track, overflow tree-shaded streets, and clamor for rooms in the hotel.

Washington Family Estates Restored

George Washington's brothers and their descendants once owned much of the countryside surrounding Ranson, West Virginia. Today, 25 miles of whitewashed fences enclose the Washington estates, restored by a West Virginia industrialist, R. J. Funkhouser. His O'Sullivan Farms (named for the rubber corporation), including 16 historic homes and farms, cover more than 6,000 acres.

Built by two of Washington's grandnephews, restored 34-room Claymont Court and smaller Blakeley are seats of O'Sullivan Farms' cattle- and horse-breeding activities. Reminiscent of colonial plantation days, the Farms form a community which is practically self-sustaining. When I visited Claymont Court, Mr. Funkhouser's home, the frozen-food unit was well stocked with meat, chickens, and fresh vegetables, all products of the farm. Milk and butter were supplied by O'Sullivan cows.

Mr. Funkhouser also bought and restored Happy Retreat, home of Charles Washington. Though within the Charles Town limits, it is included in the Farms.

Berkeley County's seat, Martinsburg, works hard. Smoke belching from factories and freight-yard trains pervades the bustling streets of the business section. One factory produces more than 18,000,000 bricks annually, enough to build 1,800 six-room brick-faced bungalows.

Large mills of the Interwoven Stocking Company, makers of men's socks, turn out almost 25,000,000 pairs a year, enough to meet the needs of about a third the male population of the United States (page 29).

* See "Pirate Rivers and Their Prizes," by John Oliver La Gorce, National Geographic Magazine, July, 1926.

† See, in the National Geographic Magazine: "Potomac, River of Destiny," by Albert W. Atwood, July, 1945; and "Down the Potomac by Canoe," by Ralph Gray, August, 1948.

‡ See "West Virginia: Treasure Chest of Industry," by Enrique C. Canova, National Geographic Magazine, August, 1940.

Tradition Says Hessian Prisoners Carved Annfield's Woodwork after the Revolutionary War

Matthew Page built this home near Berryville, Virginia, and named it for his wife, Ann. A portrait of the owner, William Bell Watkins, hangs above the mantelpiece. His daughter, Virginia, is reading.

A Glorious Autumn Day Calls Hunters and Hounds to the Chase — Blue Ridge Hunt Leaves the Grounds of Castle Hill, Millwood, Virginia

Pastoral Peace Belies This 117-year-old Bridge's Past. Civil War Troops Trampled over It at Antietam Battlefield

A Veritable Palace for the Dairy Herd Is This Kingsize Barn near Clear Spring, Maryland

Fruit by the Acre Becomes Apple Butter, Applesauce, and Apple Juice at a Linkwoodlie, Vermont Cannery

A Man of God Talks to Blue Ridge Mountain Children about Nature's Wonders on Farmers Ridge, Overlooking the Shenandoah Valley

Summer and the Shenandoah Caprices Bathers at a Sparkling Cascade near Woodstock Virginia

Nature, Using Water as a Chisel, Sculptures Masterpieces Beneath the Suwannee Valley

[illegible]

Clarke and Frederick Counties mark the beginning of Virginia in the Valley. The former, smallest of the 13 counties, yields apples and thoroughbred horses. This is the [illegible] settlers came from Tidewater Virginia. Thomas Lord Fairfax, Englishman, settled at Greenway Court and gave young George Washington the job of surveying the more than 5,000,000-acre proprietary of the Northern Neck of Virginia.* Tradition says that a disappointment in love made Fairfax a misogynist and that no woman was allowed on his estate.

Through a grant by Lord Fairfax, Matthew Page inherited land in Clarke County on which he built Annfield (page 9). Present owners now use the original spelling, although for many years the estate was known as Annefield. "The Custis family Bible says Mrs. Robert E. Lee was born here."

From Clarke County's seat, Berryville, to Winchester, seat of Frederick County, the winding road passes through the vast apple orchards of United States Senator Harry Flood Byrd (page 25).

From wind-swept summits of the Appalachians the Valley is a patchwork quilt of green, brown, and golden fields through which the Shenandoah weaves a curving silver thread. It's like looking through the large end of a telescope and seeing far below tiny towns with doll houses. But these "tiny" towns, Winchester, Staunton, and Waynesboro, are industrial cities, each with populations of more than 10,000 persons.

Winchester, Old in Years, Modern in Ways

Oldest Virginia city west of the Blue Ridge, Winchester was founded in 1744 by Col. James Wood. In 1752 it was named for his birthplace, Winchester, England. In its older section houses built flush with shaded streets hide their gardens in the rear; newer homes proudly display their flower beds in front.

Largest industrial plant in Winchester is the O'Sullivan Rubber Corporation, originators of rubber heels for shoes. This plant turns out 150,000 pairs of rubber heels and soles a day (page 29).

Symbol of Winchester is the apple. I visited one of the town's big cold-storage apple plants and saw room after room filled with apples, in crates and bushel baskets. One room was so chock-full of loose apples that walls had disappeared from view and only a portion of the ceiling was visible.

Of the average 2,500,000 bushels of apples from Frederick County's 700,000 trees, this one plant can hold a million and a half.

From all parts of the country thousands come each year to see the Apple Blossom Festival, held on the campus of privately endowed Handley Public High School.

Wandering along Winchester's streets, whose names reveal the nationality of her founders, visitors linger to see historic shrines. Within one block on Peyton Street are the site of Fort Loudoun, built by George Washington for defense against French and Indians, and the house where Stonewall Jackson had his headquarters during Civil War days.

On Amherst Street is the house where Daniel Morgan, Revolutionary hero of Saratoga and Cowpens, died.

From the present Elks Club building on Piccadilly Street Philip Sheridan began his famous ride to Cedar Creek.

During the Civil War the Shenandoah Valley was called the "granary of the Confederacy." Winchester, northern gateway to the Confederacy, changed hands more than 70 times. Both Federal and Confederate troops marched up and down the Valley Pike so many times that it was known as "the soldiers' racecourse."

Between Front Royal and Strasburg looms rugged Massanutten Mountain, the range which cuts the Valley in two for about 50 miles. Here the Shenandoah divides into two branches, the North Fork draining the wider western valley, the South Fork meandering through the narrow eastern valley.

Explorer John Lederer, reputed to have been the first white man to see Shenandoah Valley, may have come through a gap near Front Royal in 1670. Looking down at the curling white smoke rising from Front Royal's factories, I wondered what he would think if he could see it now.

Front Royal, seat of Warren County, is the northern gateway to Shenandoah National Park. Today the town is dominated by a giant viscose rayon plant, which employs 3,000 people. When I first visited the sleepy rural village in 1940 it was beginning to recover from the sudden influx of tourists streaming southward to the park. Homes had hung out neon signs to attract them; restaurants, gas stations, and "ye olde gifte shoppes" had mushroomed up and down the main street.

Shenandoah National Park, extending 95 miles along the crest of the Blue Ridge from Front Royal to the vicinity of Waynesboro, Virginia, has about 194,000 acres. Altitudes vary from 600 feet above sea level at the northern entrance to 4,049 at the summit of Hawksbill Mountain.

* See "The Travels of George Washington," by William Joseph Showalter, NATIONAL GEOGRAPHIC [illegible]

Turkeys or Hunters Any Time of the Year!

[illegible]

Soon after the park was authorized by act of Congress [illegible] nurtured 1,000 acres and presented them to the park.

[illegible] park [illegible] coming from every State in the Union, the District of Columbia, Canada, and foreign countries. To the botanist and the ornithologist the park is a paradise. More than 700 species of birds, plants, and vines, and [illegible]

[illegible] the park along the backbone of the Blue Ridge from Front Royal to Jarman [illegible] Skyline Drive [illegible] the park is to Appalachian Trail for [illegible]

According to [illegible] *Shenandoah* was [illegible] the Stars. [illegible]

[illegible]

[illegible] Nation [illegible] families [illegible] in the hills and hollows of the Blue Ridge [illegible] generations [illegible]

[illegible]

[illegible] Old World [illegible] have changed their [illegible]

Within [illegible] Margaret [illegible] Rosamond Darrow Whittle [illegible] who had worked [illegible]

"These people are of good stock," he told me. "You'll find them [illegible] I think they are the salt of the earth. Many writers have played up the illiteracy and the moonshining found in some parts of the mountains [illegible] true picture.

With almost no exception, [illegible]

Scoggins, Headlights and Miner's Lamps Pierce the Gloom of a West Virginia Limestone Mine

[illegible]

visited had a picture of Christ on the wall and a Bible on the table. And in almost every house, simple homespun prayers were offered for the minister and sometimes for me, too, with a sincerity that touched the heart.

Our first stop was in the Mill Creek section near Luray, seat of Page County, where we visited Bob Lam and his wife, Lessie. Bob, who had formerly lived in the park area, had been able to buy his farm when he moved, partly with money earned by raising ginseng, an herb exported largely to China.

Quaint Speech and Archaic English

"Do stay for lunch," Mrs. Lam said. "But I'm a warnin' yer, a short horse don't need no curryin'."

"What does that mean?" I asked.

"Means I don't have much to offer yer, so it won't take long to fix it."

When we sat down to a table loaded with roast pork tenderloin, string beans, hot biscuits, scalloped potatoes, hot applesauce, cake, and steaming coffee, I wondered what a "long" horse would have provided. Except for the coffee, all the food was raised on their farm.

The Blue Ridge is composed of a number of ranges with hollows, or small valleys, between them. A small cabin in a hollow high up in the mountains outside the park was our second stop. I met a widow whose husband had died before she had to move out of the park.

"Who built your house for you?" I asked.

"The men from hyarabouts give what time they could and built it for me. They sure holped me agley."

The use of the archaic word "holped," for "helped," was the only time I heard old English spoken when I was in the mountains.

Torrential downpours made hard driving up steep, slippery clay roads. In search of a sampler of Old World ballads, I tried one day to drive the Geographic car up one of these sick roads, with no luck. We took to the foot trail and, after climbing a mile through oozing mud, came to a clearing high on a windy hill. There, snuggling down into the ground as if to protect itself against the weather, was a rough-hewn log cabin.

Through the window I heard the strains of a hillbilly song, the only one I heard while in the mountains. On the front porch a young gal was beating a rag rug in time to the music, broadcast from a local radio station!

The little old lady who had once sung ballads couldn't, or perhaps was too shy, to remember any of the words or the tunes.

But the wet climb up the mountain was worth while when, slowly shaking her head, she said, "We don't get together no more to sing. Seems like that's so much abustlin' and abustlin' in the world nowadays, folks don't have time for them kinda things no more but I do listen to the radio."

Her few words told the story of how modern civilization has brought a different way of life to the mountain people.

In a crowded one-room school some of the children grouped themselves around the center stove and sang the ballad of *Little Doris Dean* for me. Written by one of the mountain folk in 1914, the ballad tells of a four-year-old girl who wandered away from her mountain home in the Blue Ridge. It begins:

> At the foot of the Blue Ridge Mountain,
> By the rest of the world unseen,
> Stands a little mountain cabin
> The home of Doris Dean.
> The first four little summers
> She played around its door,
> And then it seemed that Heaven thought
> There wasn't room in more.

Later I talked with one of the searchers, a God-fearing mountain man. "We found her with rattlesnakes all around her," he told me, "but them snakes didn't tech her. Yer know why, ma'am? 'Twas cos the hand of the Lord was on little Doris Dean."

Valley bisecting Massanutten separates the counties of Page and Warren from Shenandoah County. Connecting link is the curving Luray-New Market road (U. S. 211), which follows an old Indian trail up the mountain.

Shenandoah County, named for the river which winds slowly through the land, was settled by German farmers attracted to its [illegible]. Road mileage between Strasburg and Woodstock, the county seat, is only 12 miles, but between the two towns the broad silver ribbon of the North Fork of the Shenandoah River loops back on itself several times, making the river distance 30 miles.

South of New Market a roadside marker designates the southwestern boundary of Lord Fairfax's land grant.

Near by, the Green-Hale Chinchilla Ranch specializes in the breeding of these little rodents. In one house, air-conditioned in summer and heated in winter, each pair of chinchillas has its own apartment and nursery.

The Shenandoah Valley is visited by thousands each year. Recently your Society received a letter from a member in Bombay, India, who plans a trip to the United States and yearns "to travel down the east coast paying particular attention to the Shenandoah Valley."

Fair are her meadows, fairer still her distant mountains; but under the Valley's floor Nature has carved masterpieces, the famous

These Thousands of Rayon Threads May Become Your Lingerie or Blouse

[illegible]

[illegible] wonderlands, [illegible] Massanutten, Crystal, Shenandoah [illegible] are [illegible] Valley [illegible] Page [illegible].

[illegible] Valley [illegible] and [illegible] [illegible]

[illegible] Spotsylvania [illegible] pilgrimage [illegible] Knights of the Golden Horseshoe, early society of explorers led by [illegible] Spotsylvania [illegible] Virginia.

[illegible] trumpets the Governor, in green velvet riding habit, boots and plumed hat, started with his little band of [illegible] from Germanna on the Rapidan. Unlike most early explorations in America, this expedition [illegible] a gala affair, with the festivity of a New Orleans Mardi Gras.

Well provisioned with liquid refreshment, these convivial gentlemen reached [illegible] on the September afternoon in [illegible] and recorded: "We had a good dinner and after it we got the men together and loaded all their arms; and we drank the King's Health in Champagne, and fired a volley, and the Princess in Burgundy, and fired a volley and all the rest [illegible] and fired a volley."

From Swift Run Gap I followed the Spotswood Trail down the mountain into Rockingham County. I must have parked the car on the [illegible] Spotswood [illegible] on his horse and exclaimed, "This is the Garden of Eden!" The lush woodlands were touched with fiery fingers of sumac, and Virginia creeper held red green pines and broad yellow oaks in its embrace. Cotton-white clouds sailing across the blue sky [illegible] Mountains [illegible] Massanutten Mountain [illegible] the broad, verdant valley.

Many tales are told about the origin of

No Ice Cubes Are Needed to Chill the Water in This Springhouse: Sugars Glen, Virginia

[illegible]

[illegible]

[illegible]

'Mama no,' was the reply.

[illegible]

'Mama no.'

'Well then, why is it [illegible]?'

'Mama, [illegible]'

In reading Brockenbrough's [illegible] in German Farming, the Valley women in that [illegible] of the producing world [illegible] State. Southern [illegible] [illegible] of Mississippi. Mississippi [illegible] the wide Valley [illegible]

Experiments in Conservation

[illegible] Mississippi Valley [illegible] Valley [illegible] [illegible]

[illegible] Rockingham farmers [illegible] of our farms [illegible] established a representative [illegible] Mutual Fire Insurance Company.

Today, milk, poultry, meat packing, cold storage, and electric cooperative associations are mutually owned and operated.

[illegible] of the East." Last year the county produced 500,000 turkeys, almost half of the State's entire crop. It takes seven months to produce one 20-pound turkey. But at Broadway, Virginia, a processing plant can dress 5,000 Thanksgiving birds a [illegible]

Farmers are not one- or two-crop men. On individual farms turkey raising is worked in with crop rotation. Blood-tested poultry is housed in the midst of an apple orchard; or milk cows and beef cattle graze on one hill while sheep jump lightly over rocks in the adjoining field.

Practically every sizable town has a cooperative cold-storage locker plant for freezing and storing foods (page 18). Farmers slaughter their cattle and hogs and store their meat in rented individual lockers.

Vitamins and Antibiotics from Elkton

Near Elkton, one time camping ground for Stonewall Jackson's army, Merck & Co., Inc., manufacturing chemists, supplied our armed forces during World War II with tons of anti-malarial atabrine. Today the plant helps supply vitamin-conscious Americans with thiamine and riboflavin and produces the new antibiotics, streptomycin, dihydrostreptomycin, and penicillin (page 7).

At Harrisonburg the Bible School of coeducational Eastern Mennonite College trains students to serve in the Mennonite Church. It was the afternoon recreation period when I arrived. Wearing white caps so tiny that they looked like baby bonnets and armed with tennis rackets, girls poured out of the buildings. Reaching almost to the tops of their ankle-laced tennis shoes, their gay print dresses were a contrast to black cotton stockings.

When I mentioned the color and length of the dresses to a school official, she replied, "I believe you have in mind the Amish Mennonites. We are more liberal. As to length, we do not prohibit the girls from wearing shorter dresses. We leave that to the dictates of each girl's conscience."

Coming out of the building, I heard that American two-toned "wolf whistle," with the accent on the last tone. Written, it might look something like "Whew—*ooheee!*" I couldn't repress a smile when, looking in the direction from which the whistle came, I saw two teen-aged Mennonite boys waving to me.

Today in the Shenandoah Valley rural singers use some of the same syllables employed in medieval times. Because they sing [illegible] a, fa, sol, la, and mi, instead of do, re, mi, fa, sol, la, and ti, they are called "fasola" singers.

In a Blue Ridge mountain cabin I heard one of the mountain people sing from a "shape note" hymnal. Starting on absolute pitch, without the aid of even a tuning fork, he sang in a high falsetto, using the syllables, fa, sol, la, rather than the words. He told me his singing-master father taught him to "hear" the musical sound of each note by its shape.

At a farm near Harrisonburg, German Mennonite Joseph Funk printed his shape note [illegible] more than a century ago. Today in the [illegible] village of Dayton, Virginia, his descendants still print shape-note music.

Stepping off the street into the little publishing house, I closed the door on a modern world, to spend a delightful half-hour in an Old World atmosphere. At his roll-top desk, littered with letters, letter books, and sheet music, sat Funk's great-grandson, Will H. Reddish, puffing on his corn cob pipe.

"So you want to know something about shape notes, do you?" he asked, pushing back his green eyeshade and fumbling through the mass of material on the desk for a blank sheet of paper. "Can't ever find anything. Got hundreds of letters to answer from all parts of the country. Answer them myself. Our books go to every State in the Union."

In a fine Spencerian hand he wrote down the seven notes and their shapes for me: do, ◢; re, ▭; mi, ◆; fa, ◺; sol, ○; la, ▭; and ti, ▼.

Augusta County, Rockingham's southern neighbor, clings to old customs. Every year a modified jousting tournament is held at the base of Natural Chimneys, the seven Cyclopean towers of rock which rise more than 100 feet above a level plain.

It all started, I was told, when a local belle, courted in the summer of 1821 by two swains, was unable to choose between them. Someone suggested she "bestow her favor" upon the winner of a modified jousting test. The event was such a success that Valley families have held a tournament every year.

Folklore of Mountain People

Some of the people living in the Allegheny Mountains have retained the folklore of their Scotch-Irish, English, and German ancestors.

At a guest lodge in the Alleghenies the owner asked me if I had ever heard of the custom of "bellsnigling."

About a week before Christmas the men wearing women's clothes, and the women dressed in men's clothes, all wearing home-made masks, come to her door, she told me

'I'm supposed to guess who they are.'

The custom is similar to beggars' night, before Halloween, because handouts are expected.

Later I found the word is derived from German Palatinate dialect, *Belshnickle*, or *Belsh Nickel*, meaning Santa Claus.

These people have words of their own. Diapers are "hippons" and a chipmunk is a "ground rabbit."

When a child doesn't grow, in these mountains, you measure him with a string, then put the string in a rut in the road. When a car runs over the string the evil spell will be broken and the child will start growing.

Staunton: Roller-coaster Town

Staunton, like Rome, is built on seven hills. Legend has it that present steep streets followed Indian trails. On one hill is the gleaming white-brick house in which President Woodrow Wilson was born.

This roller-coaster town pioneered the council-manager plan of government in 1908. By the close of 1948, more than 800 cities, towns, and counties in the United States had adopted this form of government.

Staunton's identifying landmark is the twin peaks, Betsey Bell and Mary Gray.

In old Trinity Church the Virginia Assembly took refuge during the Revolution. Riding back roads, John Jouett, Paul Revere's Virginia counterpart, warned the Virginia Assembly at Charlottesville and Thomas Jefferson at Monticello that the British were coming.

At Waynesboro, Virginia, is Fairfax Hall, Junior College, girls' school, named ironically for the woman-hating Lord Fairfax (page 17).

In the 1920's the village awoke one morning, rubbed its sleepy eyes, and found Industry sitting on its doorstep (page 21). Today, with a population of 10,000, the town retains the charm and leisurely appearance of a rural Southern village. Outstanding visual finger print of industry is the ball seat in the mountainside above the town, caused by steam shovels digging gravel for Chesapeake and Ohio Railway roadbeds.

On the Valley Pike between Staunton and Lexington roadside markers point the way to the birthplace of Sam Houston, winner of Texas independence, and to the little blacksmith shop where Cyrus McCormick perfected the reaper.

At Lexington, seat of Rockbridge County, two Confederate generals, Robert E. Lee and Stonewall Jackson, are buried.

The mellow colonial buildings of Washington and Lee University stand beside the castellated barracks of Virginia Military Institute. I stopped outside VMI barracks to watch gray-clad cadets salute the statue of Jackson, which stands guard over the parade ground (page 6).

On this field once drilled the former Secretary of State George C. Marshall.

Within these barracks once taught Matthew Fontaine Maury, oceanographer, whose wind and current chart of the North Atlantic revolutionized the science of navigation. Today every pilot chart issued by the Hydrographic Office of the United States Navy carries a note that it is founded upon Maury's researches.

Another man who became a VMI professor, John Mercer Brooke, invented a deep-sea sounding apparatus. He and Maury, working together in earlier years at the U. S. Naval Observatory in Washington, D. C., made practicable the laying of the first Atlantic cable.

Rockbridge, southernmost of our counties, was named for the Natural Bridge of Virginia, water-carved limestone block which arches 90 feet across a gorge. Everywhere I had traveled in the Valley it seemed that George Washington had been there before me. Natural Bridge of Virginia was no exception. The initials "GW," on the southeast wall are supposed to have been carved by Washington when he surveyed the bridge.

Thomas Jefferson paid George III of England 20 shillings for the bridge and 157 acres of land less than a year before the first shots were exchanged between Americans and British in the Revolution.

From a sound-reproducing device at the top of the bridge a musical program is presented each night. Strolling toward the bridge, I heard the glorious opening notes of the Pilgrims' Chorus from *Tannhäuser*. The rich, swelling tones of a mighty organ, caught under the arch of the bridge, echoed throughout the glen until the whole night was filled with music. It seemed a fitting climax to my journey. I imagined I could hear the marching feet of those who had been there before me—Washington, Jefferson, and all the countless others who, from the Valley's mountainsides, let freedom ring.

The next day, leaving the Valley, I stopped for gasoline at a small combination country store and gas station. Out hobbled a little old man, his face lined with wrinkles.

"See you been a lot of places in this hyar country," he said, looking at the sticker covered bumpers. "Whatcher think of it?"

"I like this part of the country so much I'm going to write a story about it," I replied.

He winked. "Oh, sure, ma'am. So am I—some day!"

Perhaps he'll believe me now.

Sulphur Spray Protects Apple Trees from Scab at Senator Harry Brooks Berryville Orchard

Built to Withstand Weather's Ravages, the Covered Bridge Is a Cherishing Relic of Rural America: Near Broadway, Virginia

Young Riders from Massanutten Military Academy's Summer Camp Cross a Shenandoah Bridge near Woodstock

The Camera Looks into a Mirror and Pictures the Chinese Culture Class at Mary Baldwin College, Staunton, Virginia

[illegible]

Well-rounded Hours—35 Parts an Hour*

[illegible]

Not Sewing Socks, but Clipping Hirsuts

[illegible]

When the Podder's in the Shock, It's Cornhusking Time in Rockingham County, Virginia

"Lost" Arts Live: Virginians Still Weave Baskets and Rug Rugs

[illegible]

Sunbrewer, Wood Range, and Oats Reward Us All — Grandma's Kitchen on the Farm

[illegible]

Shells Take You Over World Horizons

By Rutherford Platt

SHELLS "have everything." Some stay-at-homes collect them as they would stamps or coins, by ordering from a catalogue. Others go exploring down to the sea or up to the hills, to pick up their specimens. Shells can be traded with correspondents in all parts of the world. Once you have a tidy collection, the fun begins.

I dislike the phrase "shell collecting." It seems to narrow the subject to accumulating or cataloguing. One may enjoy shells as exquisite jewels. Their beauty is an inspiration. They have a life and a language. Is not a pearl the product of a shell? A pair of amber-colored marginellas make exquisite little earrings.

Many people enjoy them as they delight in flowers for colorful arrangements on kitchen window sills, living-room tables, mantels, or bookshelves. Glance through the color pages in this issue of the NATIONAL GEOGRAPHIC MAGAZINE, with an eye to the decorative values of these radiant tones and patterns, and imagine their possibilities (pages 36 and 84).

Shells Have *Arabian Nights* Stories

Then too, you can tell your friends their stories, such as the miracle of the octopus in the argonaut; the incredible speed by which a broad, round moon shell dives into firm beach sand to eat a clam; or the strange way a mussel, apparently fixed with tough bonds to a rock, moves about.*

You can travel with shells, if not personally at least in books and research, to the "steaming stillness of an orchid-scented glade" where brilliant land snails are discovered along the jungle trails of Cuba or Luzon. For the tree-climbing *Liguus* run your eye and hand along the branches of gumbo limbo and Jamaica dogwood on the Florida Keys.

You may know the fresh sting of salt sea spray and the fragrance of seaweed where the mollusks of the Maine coast hide in the tide pools and crevices of that wonderland of rocks (page 41).

You can explore along the broad curving beach at Indian Rocks, Florida, in pursuit of the coquinas that hastily burrow into the sand after each retreating wave. If you are agile, you will catch them by the score and admire the variety of lovely sunsets painted in their porcelain in imitation of the sunsets that illuminate the Gulf horizon between the casuarina trees (page 48).

In Miami, Florida, a hundred collectors specialize in tree snails from the Keys and Everglades (page 76). They like to go forth to do their own exploring with binoculars over their shoulders and armed with collecting box and a sandwich.

Another person may choose to specialize in scallops (*Pecten* is the scientific name). They are a royal, highly distinctive genus with world-wide range (page 49). A big yellow scallop comes from the sea near Bar Harbor, Maine, a pink scallop from deep water near Puget Sound; and the South Pacific abounds in scallops ranging from dazzling brilliance to the most delicate tints.

There are many kinds of shells, any one group of which has enough alluring material for a lifelong study: chitons, murex, olives, cones, snails, clams, tree climbers, limpets, rock dwellers—take your choice.

On the other hand, your special interest may be a geographical location: the west coast of Florida, the New England shore, the Mediterranean, Mauritius, New Caledonia, the Philippines, the Indian Ocean, the Michigan lake region, or the hills of Hocking County, Ohio.

Collectors also specialize in certain sizes. For example, an astonishing number of shells are between ⅛ inch and ½ inch across (page 72). Most of the 100,000 species already known and named are less than half an inch and range down to microscopic. In the largest bracket, a collection is not complete until it has a giant clam (*Tridacna gigas*), which may weigh 500 pounds (page 82).

An entirely different appeal can be found in the biology of shells. The science of the shell alone is called conchology. But a detached shell is a by-product of an immense animal phylum called Mollusca. Shells are not like crystals, rocks, and ores, formed by elemental forces of earth and sky; nor are they stamped out instantaneously like coins.

Shells are the products of a group of animals [illegible] fossils [illegible] from the Paleozoic era more than 300 million years ago, the earliest time from which any kind of animal remains are known. Dr. Paul Bartsch of the U. S. National Museum in Washington, D. C., says that these fossil shells "bear evidence that these earliest known animals were already so highly specialized as to force us to the conclusion that their ancestors arose far back beyond Paleozoic times."

* See in the NATIONAL GEOGRAPHIC MAGAZINE "Sea Creatures of Our Atlantic Shores," August, 1936, and "Oysters of Our Warm Atlantic Waters," February, 1937, both by Roy Waldo Miner.

"Look! Lookie What I Found, Grandma. All by Myself!"

Natural History Photo [illegible]

Baby Sister Listens to the Sound of the Sea in a Big Shell

[illegible]

[illegible] Rise of the Moon [illegible] Mangrove [illegible] of nuclear [illegible]

fresh-water streams of British Columbia and Labrador have their pearly-hue mussels.

The Shell Is the Skeleton of an Animal

To bring [illegible] on the [illegible] animal [illegible] as are [illegible] or [illegible] low animal [illegible] often without heads or [illegible] recognized [illegible]

[illegible] animal is not even spirally curved. It is the shell which [illegible] the animal, and [illegible] vice versa. A slug—that is a snail without

Shells as a Decorative Motif for the Home

Lobsters, two forms of the Moon Snail [illegible] Two [illegible] and the Tulip [illegible] hand to be [illegible] with the bottom [illegible] two [illegible]

a visible shell is typical of the humble aspect of mollusks. Nevertheless, to the person with a biological turn of mind it is one of the most thrilling divisions of animal life.

The mollusks are a clear-cut classification and not to be confused with shellfish generally. For example, the sea urchin (phylum Echinodermata) has a shell with a wonderful pattern. But the urchin, like its near relative the starfish, is built with radial symmetry; [illegible] radiates from the center like a wheel, while the mollusk animal has bilateral symmetry; that is to say, it tends to be long and two-sided like a worm.

The shell of a sea urchin is a single layer, growing all over its body all at once. You can see at a glance that this shell is an entirely different texture from that of the mollusk. The crab, lobster, and shrimp (Crustacea) also have conspicuous shells. This group is distinguished by its jointed limbs and segmented antennæ and other parts, while the poor little mollusk is just a soft unsegmented creature.

The shell of the crab also is a single layer, growing only in thickness. That of the mollusk is usually three layers, built by being added to gradually at one end. Moreover, the crab shell is cast off and renewed periodically, while the mollusk shell is a permanent covering.

The difference in texture between a crab or lobster shell and that of a snail or oyster is easy to see. The crab shell contains about 15 percent phosphate of lime mixed with the carbonate of lime. The mollusk shell, however, has only a trace of the former. It is the carbonate of lime which produces porcelainlike shells with enameled surfaces, as in the aristocratic cones, volutes, and cowries, or layers of mother-of-pearl that glow on the inner sides of the mussel, abalone and oyster.

Even Admiral Nimitz's Daughter Is a Shell Enthusiast

[illegible] Above these are some valves of the Pearl Oyster [illegible] In the right of these is a Scorpion Shell, *Murex pecten* (page 38, No. 14). A Chambered Nautilus lies left of the box holding Miss Nimitz's knee (page 5).

their habitats mollusks are frequently [illegible] move (page 401). The squid is one of [illegible] in the sea. It [illegible] the water like an arrow. The scallop [illegible] swimming clam. The snail walks with [illegible] pull itself along.

Some of these mollusks [illegible] after food like other animals. Others [illegible] well located, [illegible] by Nature to keep animal [illegible] and the shell collector must either catch them like any other hunter or dig them out of their hiding places; or else pick up empty shells left by departed animals.

The Univalves Far Outnumber the Bivalves

Of the two chief categories of shells, the larger is that of the single-shelled, the univalves. You will find twice as many kinds of these along the seashore as you will of the

Enhancing Her Charms Are Chaplet and Belt of Cowries

Many a [illegible] which tells [illegible]

two-shelled. This [illegible] of mollusks includes the snails and their great variety of spiraling relatives, plus slugs and limpets. The univalve is a marine, fresh-water, land, and tree inhabitant.

This small type is the higher form of mollusk so that it has evolved a body better equipped for living. The univalve has a head with [illegible] tentacles, and eyes. It may have also [illegible] extend twice the [illegible] The teeth on this tongue may [illegible] thousands, and new teeth grow when old ones are worn out.

[illegible] for this [illegible] which, trans-

lated from the Latin [illegible] "stronghold."

The [illegible] the shell [illegible] animal [illegible] and the last part withdrawn, [illegible] [illegible] fortress, this disc, [illegible] seals the doorway.

The operculum meaning "lid," is found [illegible] the shell [illegible] it [illegible] [illegible] its purpose.

If you look closely you will see that the operculum [illegible] structed on a spiral pattern, [illegible] many shells. [illegible] tal of the [illegible] is on a flat surface, or plane, while that of shells is normally pulled out to make the [illegible] ultimate form. The collector [illegible] to find the operculum [illegible] it is tough and [illegible] and can be [illegible] and kept in place in its univalve [illegible] [illegible]

Most Bivalves Live in the Sea

The other big category is that of the two-shelled, the bivalves. These are mostly marine, although there are many freshwater clams and mussels. No land or tree mollusks [illegible]

[illegible] has seen [illegible] the [illegible] translated [illegible] The foot is a wedge-shaped organ for digging. It can work so fast that [illegible]

[illegible]

[illegible] a remarkable [illegible]

[illegible]

It may [illegible] that the [illegible] squashy animal can create such wonderful [illegible] the phenomenon is the more remarkable [illegible] accomplishments of Nature. [illegible]

[illegible] animal into the forms characteristic of its kind and painted with pigments synthesized by this lowly creature from chemicals in its environment. Momentarily this material is soft, but it quickly hardens, whether under the water or in the air, to become one of the most [illegible] materials in our world, as witness the fossil shells that pave man's pathway [illegible]

[illegible] the largest [illegible] and their houses [illegible] with multitudes of these [illegible] shells. The American Museum of Natural History in New York City [illegible] the Smithsonian Institution in Washington, D. C., [illegible] neat and in order.

Yet even after the museums have taken their great collections, and the private collectors have [illegible] the mountains, the rapidly [illegible] the [illegible] of Miami, Florida, or Coronado, or wherever else [illegible] pick up equally beautiful and startling specimens newly arrived after the last storm [illegible]

The Shell Is a Work of Art

[illegible] a curving beach set between [illegible] "sea oats," shimmering [illegible] and the silver in aqua [illegible] Is it mere fantasy to say [illegible] its band of [illegible] opening on one page and the curves of white foam from broken waves following it on the other, forms the same curve that you find in [illegible]

Look at a wave as it advances into shallow water. It is pushed up, growing higher and steeper from the opposition of a spent wave

Through Shell Eyes the War Canoe "Sees"

[illegible]

Scarlet Tentacles Fringe the Moving Valves of the *Lima lima*

Propelling itself by opening and closing its shell, this mollusk develops good speed through the water. [illegible] It and the pecten, or scallop, are the only bivalves capable of swimming during their adult stage. The tentacles cannot be drawn inside when the shell is closed

flowing back toward the deep, until finally the oncoming wave has no reserves left for increasing its magnitude and must topple.

But it does not readily topple. At this moment, when it is undermined by the increasing force of the undertow, the wave bends forward. In cross section it forms momentarily the pattern of a logarithmic spiral, with the crest curving in and under to place its apex at the center of gravity. This figure perpetually repeated by waves as they mount the beach forms the identical curve that you find in the cone, conch, cowry, snail, and nautilus shells.

Here we are confronted not with an imaginative idea but with a thrilling fact of life: that the dynamic spiral is a fundamental pattern of growth.

To produce a spiral, three conditions must exist. First, growth must pursue a continuous course and not be erratic or backtrack. Second, growth must proceed freely and without outside interference. Third, it must operate as a sequence with a growing tip or growing lip, or at least produce new growth following *after* older parts.

The growth of shells clearly pursues a continuous course. Their lines are not zigzag or jagged. They often have spines, knobs, and ridges, but these are protuberances on the basic spiral. Finally, each shell has a lip that generates the shell so that it is built with a sequence of increments, those near the lip being younger than those near the apex.

Because they possess this inherent spiraling ability, combined with the permanence of their structure when built, shells are the most vivid examples in all Nature of this principle of growth.

The stirring quality of the design lies in its action. It is not inert. Even though the spiral of a shell is physically stationary, it has a point of origin, called a nucleus or protoconch, from which it springs whirling toward an infinitely greater magnitude.

Snail and Scallop Inspire Architects

That this pattern of action can be impressed in hard material so as to endow what is fixed and immovable with a quality of movement is one of the characteristics of the spiral. You may say that architects and sculptors borrow from the snail and the scallop their dynamic curves to animate intractable marble with fluidity and living beauty.

A Small Collection of Birds Transect-cove in a Tide Pool at Orrington, Maine

New Zealand's "Stern and Blackbound Coast" Beach with Mollusk Shells of Many Kinds

Some of the Rarest Shells on Earth Are These Tiny Jewels

Amateur Collectors Have Given These Florida Shells Descriptive but Apt Names

Gulf Vessels Found Ashore in a Fog-Enshrouded Whale Country

[illegible]

Are Amateur Beach Searches Can Bring Dress Fossils in Florida

Loved by Tropic Waters, Florida Is the American Paradise for Shell Collectors

Fig. Wasps and the Carpenter Worlds Bees Compared. Drawn on Boxwood Blocks

[illegible]

Models of Classic Architecture, Pectens Are Natures Examples of Jet Propulsion

Unlike Its Swimming Cousins, the Pecten, the Thorny Oyster Lives Cemented to Coral Rocks

[illegible] Food Plants Volunteers or Herbs a Collector Must Travel Around the World

[illegible]

Cerithia and Turrscala Shells Resemble Augers and Screws on the Twist of a Tornado

Collecting Cones Is Dangerous, for Some Were Alive Poisonous Stings

[illegible]

With Shells Crossing, or Fully Separate Pieces, Clutions Are not a Class by Themselves

[illegible]

Mediterranean Mollusks Made Ancient Divers Artists Glorified the Shells

Found in America Only on the Pacific Coast Is the Fan Shell Called Madrona in California

The chimney of the Château of Blois is wreathed with scallops. The volute or scroll was used by the Greeks in their Corinthian and Ionic capitals. Famous at Blois is the double winding staircase, which reproduces with mathematical precision the double curves on the columella of certain turreated shells.

While the artist finds in shells rousing examples of the dynamic spiral, it would be shortsighted to assert that shells are the only source and origin of this spiral. You can see the same curves with the identical proportions, in the florets of a sunflower, in the scales of a pine cone, in the leaves of an artichoke, in the horns of the Rocky Mountain goat, in the cyme of forget-me-nots, in fern croziers, and in elephants' tusks.

The lowly mollusk simply uses a fundamental law of growth together with economy of structure, for building a strong house. The architect builds spiral staircases and columns, using a fundamental law of beauty and an economy of structure that are synonymous with the mollusk's law of growth.

The curve of the shell is one of the simplest of all known curves. Its proportions may be defined by a mathematical formula. Its dis- [illegible] tube will grow in exact proportion to its length.

You can see a beautiful diagram of this fact when you refer to the picture of the chambered nautilus (page 65). The control of its proportions is so perfect that each new coil is exactly three times the width of the coil preceding it.

Shell Growth Mathematically Exact

Another type of shell may increase at a much slower rate. For example, one terebra may increase the diameter of its coil at the rate of one and one-quarter times at each complete turn. At the other extreme, the [illegible] (page 56) [illegible] its coil diameter by ten at each complete revolution. This is purely a mathematical proportion, because the shell one curve winds so fast that the shell never gets around itself. It is merely a short segment of a wide spiral.

This type of spiral has a remarkable property. It can increase by growing at one end only and always retain without change the form of the entire figure. A little shell grows into a big one and both look the same. This is a marvelous fact, because the shell grows only at one terminal end.

Compare this with most growth. When a boy grows into a man, he grows proportionately all over. How could a shell grow all over? The animal builds a house of which each increment is forever dead, rigid material. Yet this structure, added to at one end only, continues to grow as if by magic, appearing to become larger all over!*

The diversity, which is so bewildering as we look over a collection of shells, is due to the endless combinations of this dynamic spiral. For instance, the growing edge, or aperture, of the shell may be round, triangular, oval, wide or narrow ellipses, or countless other shapes. The shape of this growing edge will vary the form of the completed shell.

An additional variation is seen in the way this aperture—that is, the cross section of the shell tube—is set at various angles in relation to the axis of the shell. One angle will cause it to go round and round, approximating a [illegible] into a long, steep corkscrew.

And another influence comes from the various velocities of growth in relation to angle of rotation. These factors of the figure of the growing lip, its angle, rate of growth in relation to twist, and so on, may be likened to the few notes of music by combinations of which all the countless varieties of tunes are produced. Thus the tens of thousands of shell forms are rooted in the simplicity of a curve with a simple formula governing its proportions.

* For a fuller description of [illegible] Growth and Form, by D'Arcy W. [illegible]

Exploring in Our Color Plates

THE 32 PAGES of color illustrations in this issue take the reader on a world-wide hunt for shells from the rock shores of New England to the humid beaches of the Tropics.

Color Page 41

The rock-bound coast of New England with its intervening beaches, teems with mollusks offering an opportunity for many thousands of summer visitors to become acquainted with the beauty of shells.

In this region the tides have a great rise and fall, sometimes 10 feet or more. When the Atlantic breakers draw back they uncover jungles of seaweed and tropical pools among the rocks.

Color Page 42

All the shells on page 42 are from the collection of the Boston Museum of Science. The Thais in the upper corners is a sharp-toothed snail with colorful stripes and a pearl-like texture. Just below these is the familiar Periwinkle, one of the commonest shells on the New England coast. The larger round snails are Moon Shells.

Thousands Up from Underneath by a Storm, Pen Shells Lie Dying on a Sunset Beach

[illegible] storm rights, live almost completely buried in the sand, and only extremely heavy waves can dislodge them. The collector has stumbled upon a scene of devastation

Sanibel Island is a paradise for shell collectors [illegible] a catchall of the vast wealth of shells borne from the Tropics by storm and current.

Here the Violet Snail comes rolling on his bubble raft; the Cockles and other Lucines are thrust up from their deep-water haunts. The transparent, delicate Paper Atamark may pile here on the breakers after a trip of unknown distance from the enchantment lands of the weather [illegible]—lucky the person who finds this fragile piece of art unbroken!

Because the beaches of Florida's east coast are steeper and deep water comes nearer to the shore, certain shells are found there which rarely appear on the west coast.

To the west coast, however, the shell enthusiast goes best. There the Leaches sheltered gradually under the Gulf of Mexico, and the most brilliant and varied wealth of shells to be found on any United States coast is tossed up by the storms from the coral reefs, sponge beds, and tropical waters.

Sanibel Island near Fort Myers is a particularly fruitful spot for collectors.

Color Page 43

You see here some of the rarest and most prized shells of the Florida collector. They are shown through the courtesy of the late Dr. B. R. Dakin of Cambridge, whose collection includes most of them. The delicately tinted Fasciolaria gemmata is from the Museum of Comparative Zoology, Harvard University, and the Cassis [illegible] comes from the McGinty collection in Florida.

The Lion's Paw is one of the world's most and most showy Pectens. The Junonia shown is exclusive to Florida. The Cameo Shells in the lower corners are curiosities; this species collects other mollusks and fastens them to itself. The Golden Banana is highly prized by collectors.

Color Pages 44 and 45

Because amateur collectors come to Florida many shells of this region are given picturesque names, as illustrated on these pages. You will note how appropriate these names are. What could more aptly call to the Lion's Ear or the Herring Tooth, or the Pole Shell? The Shark's [illegible] of the most [illegible] Moon Shells found from [illegible] due to Florida. It is carnivorous, with a powerful

Shinto Priests of Kyoto, Japan, Sound the Gong to Worship with Conchs

[illegible]

A "Naked Clam," Wearing Its Shell Inside, Lives in Mission Bay, California

[illegible]

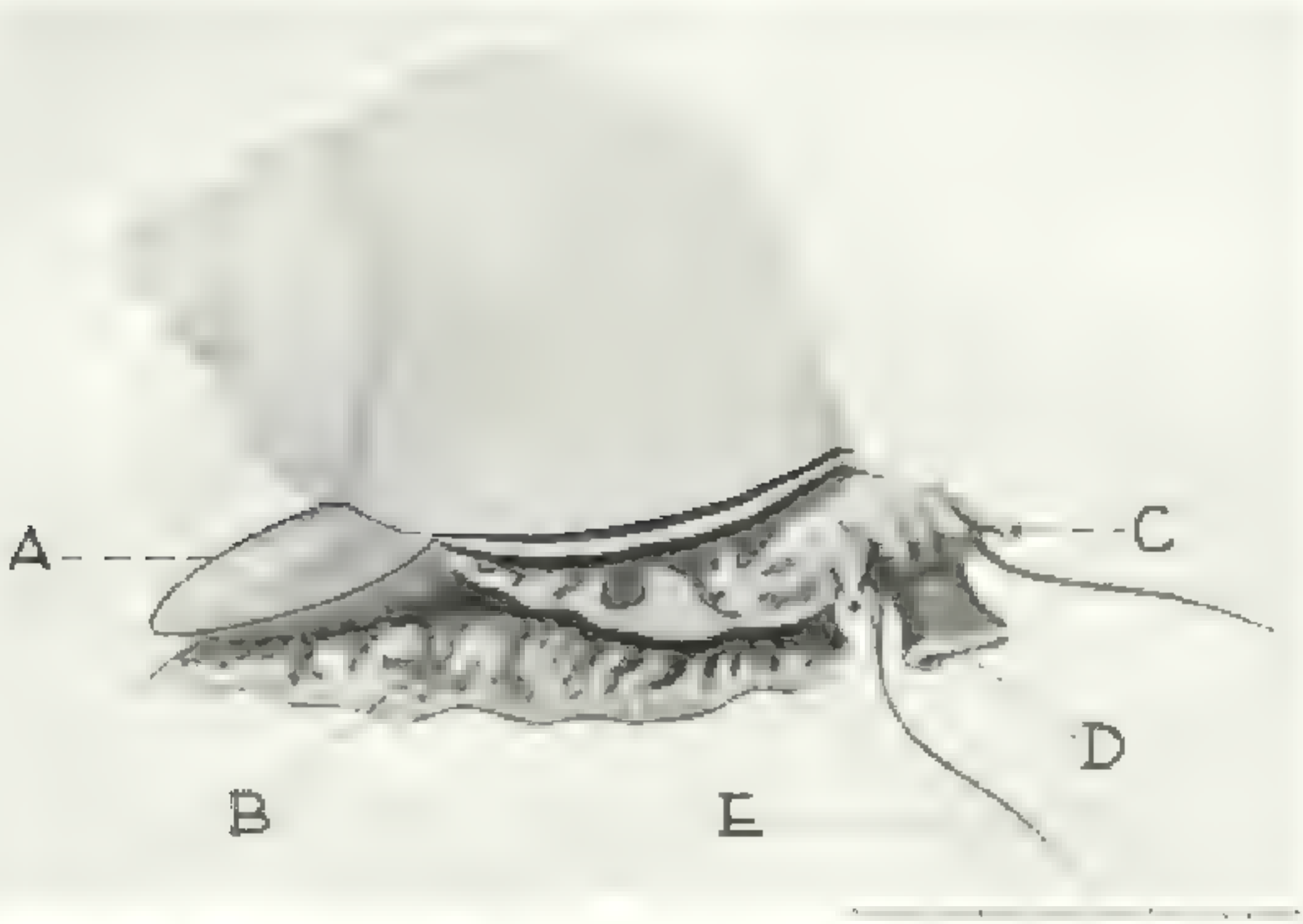
[illegible]

Color Page 46

[illegible]

Color Page 47

[illegible]



Thus Moves a Living Tapestry Snail, Carrying His Pearl-lined House

The hard, shiny operculum, or door (A) of Turbo petholatus's dwelling (page 68, No. 3), which resembles the brilliant green cat's-eye in price (as a gem). B is the foot, C the eye, D the proboscis, and E the tentacles. The mantle, which is iridescent, does not show in the drawing. Appearing as a light strip under the edge in the mantle, which produces the shell material. In the drawing the shell is in brownish nature.

Color Page 48

Cowries are sometimes called Butterfly Shells. They belong to a big group known as the Wedge Shells. Florida has a wealth of these shells, averaging about an inch long. A few are found in California, the Philippines, and Ceylon. This is the elementary sheet for beginners.

Many visitors to Florida, who have not thought of shell collecting, are first attracted by the countless numbers of cowries washed up by the small waves from the Gulf onto the beaches of the west coast.

Cowries play where the waves wash up and recede, in fog up and then suddenly disappear into the soft wet sand. They dig so fast that they disappear in a few seconds. Gourmets collect the cowries by the bucketful and boil them up for delicious broth.

Color Page 49

The Pecten has world-wide distribution and a [illegible] of colors. More than any other shell form the Pecten is a classic symbol, an illustrating symmetry. Like the fingers of our hands it is frequently incorporated in architecture. One of the finest examples is the Chateau of Blois, France, where Pectens ornament chimneys and [illegible].

On this page note that the two valves of the same animal are usually produced in different shades of color. A good example is seen in the two upper corners, which are opposite valves of the same animal. Note also how those shells with heavy ridges resemble the Thorny Oyster (page 70), except that Pectens do not have spines.

Color Page 50

The Thorny Oysters resemble Pectens, but the two valves have fantastic spines. These spines are either tiny scales or pin points or heavy spikes. Many of these shells are white. Those that are [illegible] are brilliant flaming red, rose, deep purple, salmon. They are found around the entire Florida coast, in Baja California, the Philippines, Mauritius and along the coast of China. When torn away by a storm, the Thorny Oyster is thrown up on the beach where collectors usually find it broken by the surf. To find these grotesque shells with both valves and the spines unbroken is an event.

Color Page 51

The Venus are sometimes referred to as the aristocrats of shells. They are cherished by collectors for their handsome spirals and varied colors and markings. Note the depth and character of the aperture with the inner drawn curve forming its outer edge.

In the Dance of the Skeletons French Sudan Natives Wear Their Wealth

[illegible]

[illegible]

Color Page 52

[illegible]

Color Page 53

The collector of Cones needs a world atlas for reference. The specimens selected for our page illustrate their universal distribution. Here are cones from Hawaii, South Africa, Ecuador, Singapore, the Red Sea, Mexico, and other places in the Pacific. Compared to other shell families, the Cones have remarkable regularity; all are trim and distinctive. A typical cone is about two inches long with a flat, or at a broad top, its straight sides forming a triangle. The chief variations are in the markings and color, which offer a wealth of enchanting ideas for the decorator.

The big one in the lower right-hand corner is the Geographer Cone. It averages four to five inches and has a wide aperture, giving it an outline more curved than triangular. The two Cones in the lower corners, Cones *aurisis* and *Cones geographus* are dangerous to the collector. Their inhabitants have a sting that injects a painful poison which may prove fatal. In fact, all Cones should be handled with care when alive.

Color Page 54

Chitons are the most individual of the mollusks and the most ancient and conservative family. They belong in a class by themselves. Unlike other mollusks, they have shells consisting of eight separate pieces. These pieces are joined simultaneously and do not have a spiral curve.

Science believes that the original primitive mollusk must have resembled the Chiton more than any other. In this sense it is an antique. The Chiton clings to a small rock at the water line by means of a vacuum cup the length of his foot. He is stuck so tightly that to dislodge him the collector needs to thrust a flat knife quickly and neatly him.

Most of these shells are colored in living undulation wall, the eight separate pieces held together by a surrounding girdle. Some of those on our page show this girdle, especially the large one in the upper center. When cleaning and preparing shells for collection, some collectors remove the girdle; then the pieces must be stuck together with glue to hold their form.

Color Page 55

We recall that the ancients were a maritime people, that they made dyes from mollusks. Later artists of the Renaissance, whose work lay close to the Mediterranean shores, immortalized shells. Yet the Mediterranean cannot compare with other regions, such as the South Seas or Florida, in the richness of color and variety of its shells.

In the center of page 55 is a Haliotis, a species closely related to the Abalone of California (page 56). In the upper left-hand part of the page you will see four Patelas whose special charm is the inner lining of mother of pearl. Compare these with the limpets of the New England coast, page 42, to which they are related. At the bottom you have two views of the handsome Helmet Shell. One species of this, called the Cameo Shell, appears often in Italian curio shops. Many American families have these shells carved with exquisite little cameos, as souvenirs.

Color Page 56

The Ear Shell, called Abalone in California, is the most distinctive shell of our Pacific coast. It is remarkable both for the play of iridescent colors through its incomparable mother-of-pearl and for the food value of its animal.

The Abalone is never found on Atlantic beaches; yet many Florida shell types are found [illegible] the [illegible] that the Atlantic and Pacific Oceans were connected during a late period in the earth's history.

The shells on this plate are from the collection of the Berkshire Museum, Pittsfield, Mass.

Color Page 65

The Chambered Nautilus is in a class by itself not only for the beauty of its dynamic symmetry but also biologically. It belongs to the most rigidly structured group of mollusks—the nautilus [illegible], have large bodies, well-developed eyes, and a circle of arms (tentacles), often with suckers discs, arising from their heads.

You might say that the shell on this page is the home of a member of the octopus family. It is found most commonly in the deep waters of the Pacific. The Nautilus is an animal with an ancient lineage revealed by 2,000 fossil species; yet today only three living species survive.

The Nautilus animal occupies only the largest outer chamber of its shell. It protrudes from this to swim about and to catch crabs and other animals with its tentacles. For protection it withdraws completely within its shell.

The winding tube running through the middle all the way from the open to the last chamber is called a siphuncle. As the baby Nautilus grows it builds its spiral with mathematical precision and as it moves outward, leaves empty chambers sealed with watertight partitions. According to one theory, the siphuncle enables the animal to control the gas pressure of these empty chambers and thus give its shell buoyancy to become a vehicle of transportation.

The age of this shell is unknown. The chambers do not bear any relationship to the years. One of the largest perfect specimens of the Chambered Nautilus ever found measures about 11 inches across.

Color Page 66

Some South Pacific regions have been less disturbed through the ages than other parts of the world. There the mollusk fauna, like the flora of certain South Pacific islands, is most primitive and ancient. Because of the relatively stable temperatures of the sea water currents that flow between the islands, shell forms have achieved richer colors and more imaginative patterns than in any other shell region in the world.

In this plate the coral orange Trochus valves at

top center show the heavy sculpturing of the giant Murex. This is a good 10-inch specimen, but some achieve three or four feet across; they are found in six to ten feet of water in channels between the islands.

The smooth oval shell just above the center is the Golden Cowry. This is greatly prized by shell collectors and must be hunted on the underground, so to speak, because its export from Fiji is strictly prohibited. The Golden Cowry is worn only by a chief, as a symbol of his sovereignty, like a crown. In South Sea Islands as elsewhere in the Tropics, cowry shells are used as money and a man's wealth may be estimated by the number he wears as ornaments (page 421).

Color Page 67

Among these Philippine specimens you will see one of the most distinctive and beautiful shells of the Far Eastern waters, *Lambis millepeda*. This is closely related to the Scorpion Shell, but the experienced observer will distinguish it by the two prominent notches at the top forming the letter W and the stubby notches along the sides.

In the lower center our plate shows the Golden Cowry. This is the most highly prized shell on the page. To the right of the Golden Cowry you see the famous Triton Shell (page 501), which is the prototype of Triton's trumpet used in mythological pictures.

This page is noteworthy also for the slender curved, green Tooth Shell in the upper right-hand corner. Its scientific name, *Dentalium elephantinum*, means Elephant's Tooth. A small white variety of these shells was strung by American Indians to make necklaces and for use as wampum. The shape of this shell, which appears to have neither the spines of the univalves nor the clamshell contents of the bivalves, means that it is in a class by itself.

Color Page 68

Early in the war, New Caledonia, in the South Pacific, directly east of Australia, one of the world's important outposts for shell collectors, became a base for military operations. As a result, in May, 1944, the National Geographic Society received from Lt. Gen. Alexander Patch, since deceased, one of the finest shell collections [illegible] to the United States from the South Pacific. You see here some of the rarer specimens of this collection, which has been turned over to the U. S. National Museum in Washington.

Compare the Trochus in the upper right-hand corner with the rare and highly prized Pearly Trochus [illegible]. They are closely related [illegible] 67. The Scorpion [illegible] South Seas but highly distinctive and easily identified by its sea brush. At the bottom of the page you will find three Cowries. Although not so rare as the Golden Cowry of page 67, this shell is cherished for its ornamental value in the South Seas.

Color Page 69

In our shell tour page 69 carries us south of the Philippines to the Equator and the heart of the East Indies. Here around the Molucca Sea is found a bewildering profusion of the world's most brilliant shells.

On our page the most arresting item from the viewpoint of the expert shell collector is the large Murex in the upper right-hand corner. Study it carefully. You will realize that it has a left-handed spiral. The genus shown is right-handed so that we have here a rare and unusual specimen. Most all other shells through these pages are [illegible] handed whelk on page 45. This whelk species is always left-handed and is distinguished for that reason. But individual specimens are not rare. Our left-handed twist, shown here from the beaches of the East Indies, would create a sensation in the temples of old India where left-handed shells are sacred of yore.

Color Page 70

A few especially prized or unusual shapes are gathered on this page. But you will see that many more unusual designs scattered through other pages in this series. The terrace shell in the upper left-hand corner should be compared with the small Conus [illegible] in the upper left-hand corner of page 71. In the center at the top we see two incredibly slender Terebras. Compare these with the spines related to them (page 52).

At the bottom you see the beautiful Venus Comb, characterized by its curving spines. This extraordinary shell is fairly common, but hard to find with the long bristle spines unbroken. This belongs to the *Murex* group, which produces more capricious spines and ridges than any other type of shell. Five other specimens of the fantastic Murex can be counted on this page.

At the bottom, to the right of the Venus Comb, we see a striking example of the Carrier Shell. This is a mollusk with a flap spread that collects smaller shells, bits of stone, coral or refuse and uses them on for a perfect camouflage. It resembles so exactly the bottom where it lives that it is virtually impossible to pick up casually.

Color Page 71

You see here a page of shells pronounced by the U. S. National Museum, Washington, D. C., as among the rarest in the world. To be taken rare, from a collector's standpoint, a shell should be scarce. It should be a distinctive species or type of which possibly only one or two have ever been picked up. The discovery of rare shells is the ambition of the most expert collectors, and may be the high point of a career.

Form and color are not criteria of rareness; the rare shell may be unattractive to the eye. For this reason it usually takes an expert to select them. The thousands of amateurs who seek shells are more apt to hunt for perfection and beauty, and doubtless have cast aside many rare discoveries without a thought.

A sport or a freak of a species may be a rare

The Chambered Nautilus, as It Grows, Makes First New Room Larger than the Last

Most Precious of These South Pacific Shells of Ancient Lineage Is the Golden Cowrie

To the Collector the Philippines Offer the World's Greatest Source of Wonder Shells

General Patch Brought to the National Museum: Wonder Shells from New Caledonia

Figure 1. The Mississippi Pearl Button Company's Rolling Production of Button Shells

Some Shells, Like the Cowrie, Are So Fantastic as To Be Unbelievable Until Seen

[illegible]

Some of the Rarest Shells in the World. See Them Free in the U. S. National Museum

Tree Snails Ranging in Size from a Half Inch to a Barely Visible Speck

Some Are Highlights from the Late Frederick A. Gerardi's Collection of Stones

Lavaches Do Not Fade from Time — Lavan Was Made the Famous Lavan Purple

The [illegible] Lavan Was Made the Famous Lavan Purple [illegible]

Bivalves: Clams, Oysters, Mussels. Open and Close Hinged Shells Like Doors

If Sacred trees One Kind of Tree to Another, Florida Tree Snails Will Die

Cuba Has a Wealth of Tree Snails, Close Relatives of Those in Florida

Probably the Most Brilliant Crystal Land Snails in the World Are Found in Cuba

[illegible]

Photographs Land and Tree Snails Closely Resemble Their Counterpart Colors, Hundred Miles Away

Cutting Cross Sections of Pearly Shells Harder than Glass Is Delicate Work

shell, provided its formation is natural growth and not merely a distortion. For example, on page [illegible] left-handed Melo. This would qualify for a place among the world's rarest, because the other shells of the same species are right-handed. This specimen is probably the only left-handed Melo ever found.

Perhaps the rarest on page 71 is the small white shell in the center of the top line. This was found by the late John B. Henderson, Jr., of the U. S. National Museum, when he was on an expedition to Barbados. The large cone, top-center, is the famous *Phonetoma ra adamicum*. There are a large number of fossil forms of this shell, but only a few live specimens have ever been found. These have been dredged up off the coast of Japan in 600 fathoms of water by crawlers looking for big [illegible].

Formerly, when a Phonetoma was discovered it became the possession of the Japanese Emperor. A few specimens in this country were smuggled out at a great risk.

Color Page 72

These platoons of little shells, measuring about half an inch or less, give you a glimpse behind the scenes of the vast world of tiny shells. About 90 percent of all shells are small, although the larger types usually make up the bulk of collections. Some full-grown shells are barely visible, like a speck of dust. The very tiny types, smaller in size than those shown on this page, do not have much color. Most of them are white or translucent, like a bit of lace.

The two bottom rows are Neritinas, handsomest of sea snails. The lower right-hand group, just above the Neritinas, are Mottled Dove Snails.

Color Page 73

Here you see high spots from the famous private collection of Frederick A. Constable. It consists mostly of marine shells, selected for their excellent quality, and totals about 50,000 species.

Shortly before his death, Mr. Constable donated 15,000 selected items to the American Museum of Natural History in New York. In recent years, after a study of the collection by Dr. Roy W. Miner, the balance was bequeathed to the Museum by Mrs. Constable, now deceased.

The sources of the specimens shown in our plate reveal the global origins of an assemblage such as this: Indian Ocean, China, Philippines, Tasmania, West Indies, Australia, Africa, and [illegible].

Color Page 74

For some mysterious reason, almost all of the spirals of univalves are right-handed. That is, they curve clockwise as the animal puts out its head. This is the same direction of twist as the thread of a screw. Whether this right-handed curve is a coincidence, or whether it is due to a law of physics or biology we understand is not known. Rarely, one of these right-handed shells is found curving to the left. This is a sport or a freak and as such it has special value for the collector.

The lime specimen of Murex on page 74 is a member of a large and very ancient family of shells found in all the seas. They develop fantastic spines, knobs, horns and fins as projections from an otherwise normal turbinate shell. The Murex has a rough appearance, and it is a tough actor. It is a menace to oyster beds; it bores holes through the hardest shells and feasts on the occupant.

Classical history has many references to the Murex. This type of shell collected in Mediterranean waters was the source of the famous Tyrian purple. This mollusk dye came in deep red, blue, violet, black, and green, but its most historic color was purple. The royal houses of Persia, Babylon, and Syria all wore Tyrian purple. The wealth of Phoenician merchants was derived from Murex dyes.

Color Page 75

About one-fifth of the species of mollusks in the world are bivalves (Pelecypoda, "hatchet foot"). These are the clams, oysters, mussels, and their variations. They have two mantles for producing their shells, one on each side of the animal. These mantles build the shells (called valves) with almost perfect synchronization. Each valve has an apex, or umbo, from which spiral lines of growth are pushed out in ever-increasing magnitude. Each increment of growth is usually marked by little ridges. These are not like the annual rings of trees. No one can tell the age of a bivalve by counting these growth lines. The size of bivalves runs from tiny ones like a pinhead to the giant Tridacna which may measure four feet across.

Most bivalves are slow movers. They either attach themselves to hard surfaces like the oysters, or burrow in the sand where they hide lazily. However, as we have seen elsewhere, the scallops are very active in the shallow surf.

In the lower right hand corner you will see a small species of the mighty Tridacna. Although this one is only about three inches across, others will grow to three or four feet and may weigh 500 pounds. It is said that pearl divers have been drowned when the mighty valves closed tight on their arms, trapping them underwater.

Because these monsters of the mollusk world have been in great demand—they are often used as basins for holy water in churches—they are scarce. Collectors report that it takes six men to dislodge them from reefs 60 feet under the water.

Color Page 76

The marine mollusks are so celebrated that we instinctively bid them the land snails. Yet these last make a varied and world-wide fauna. If the sea had never cast up a shell mollusks would still be famous for their dynamic spirals and the brilliance of their colors, because of those which [illegible].

The land snail likes moisture. He is found in damp spots under rocks or on the shady side of

This Giant Clam Was Dug Out of Coral in Tokyo

[illegible] Japanese stores are full of native curiosities [illegible] and [illegible]

[illegible] Southwest coast and [illegible] have their snails. They [illegible] and buries it to the sand, [illegible]

[illegible] United States crawl along the [illegible] jungles, and mount on [illegible] so that the [illegible] water in the [illegible]

When [illegible] Florida Keys were [illegible] in [illegible], much was lost

lowed a few years later by the increased tourist trade through the opening of the automobile road to Key West. The Legion [illegible] and some of [illegible] can be traced to the extinct. It is possible, however, that [illegible] travel during the war has permitted these small colonies to flourish [illegible]

They like certain trees—chiefly the Jamaica dogwood and gumbo limbo. If you take a snail off his tree and plant him on another kind of tree he languishes and dies, Dr. Bartsch reports.

[illegible] they are found in groups, because a snail will spread a [illegible] finding such a "hoard" [illegible] already spread on the [illegible] will go that [illegible] are [illegible] back to [illegible]

The food of these trees [illegible] the Legion [illegible]

Color Page 77

Our plate shows the beautiful Tree Snails of [illegible] Notice particularly the two small ones [illegible] top—both the same kind of [illegible] handed. [illegible] This is a unique characteristic of the [illegible] half grow one direction and half in the other. Some tropical islands are rich with land snails, whereas other [illegible] For example, Cuba has [illegible] as Java.

Color Page 78

The Cuban Land Snails are a remarkable group [illegible] brilliant to control of all the land snails of the world. When you look at this page, you will see how well it illustrates [illegible]

Big Enough for a Child's Bathtub Is Half a Giant Clam Shell

The little visitor to the South [illegible] is seated in a [illegible] of [illegible] [illegible] the South Pacific islands.

Shell of the Roller Shellfish Is Big as a Football Its Muscular Foot Even Larger

[illegible]

Set in Soft Velvet and Covered with Glass, Shells Make a Novel Card-table Top

[illegible]

[illegible]

Color Page 79

[illegible] few typical specimens from [illegible] and fauna that are that [illegible]

Color Page 80

To cut shells [illegible] special skill as I saw it done. The pearl [illegible] is much harder than glass.

[illegible]

Skyway Below the Clouds

By Carl R. Markwith

Illustrations by National Geographic Photographer Ernest J. Cottrell

THE DEDICATION of Skyway 1 as the Wright Way, in honor of the Wright brothers, opened a door long closed to the average amateur flyer. Planned especially for the use of private planes, the new route, when completed, will so simplify navigation that any careful amateur can fly it with safety.

As one of those amateur flyers, I saw in the Wright Way a chance to use my GI flight training. Six weeks after its dedication I started a round-trip flight over the route in a personal plane.

With me went National Geographic Society staff photographer Ernest J. Cottrell, who was even more of an amateur than I. I had a Private Pilot Certificate and had flown 175 hours in small airplanes. Ernie got his Student Pilot Certificate a few days before we took off, and did not fly solo until after we returned.

Some of our flying friends implied that we were not amateurs but professionals—professional dodos. We couldn't blame them, for our transcontinental flight took off on a train to Wichita, Kansas.

In Wichita I began to believe that I should have stayed a dodo, and at home. The man-sized wind I swing down the runway at Cessna Aircraft Field was more than I had bargained for. The company pilots laughed about my eastern caution and insisted that in Kansas they just ignored it.

Regional sales manager "Dutch" Dutton introduced me to Cessna 41602, the four-place airplane loaned by Cessna Aircraft Company for the trip.

The 602 was a perfect lady. She forgave my clumsy efforts to take off and land, and in the air was a far better flyer than I. She and Dutch soon taught me to handle her and the wind safely, if not always gracefully.

Stowing Baggage a Problem

Stowing our 300 pounds of baggage looked like an easy job. Weight had to be distributed to keep the ship in trim in the air; but there was plenty of room and spare load capacity. Parachutes, cameras, film, emergency kit, brief case, and personal gear all had to be stowed to be available when needed.

By the time they were all in place, Ernie was wondering aloud if I really had to have 13 pounds of maps; and I was sure he had at least twice as much film as he could use. We were still rearranging the load when we returned to Wichita seven weeks later.

The airways weather forecaster assured us that the weather was VFR (visual flight rules, as distinguished from IFR, or instrument flight rules), and provided wind directions and velocities above the surface. We selected a cruising altitude where there would be a helping wind and took off for Tulsa, Oklahoma. At that point we should come onto Skyway 1-N, the northern section of the Wright Way.

No Route Signs Aloft

The moment we cleared Wichita we were out on an unmarked highway. It was like driving a car on a secondary highway having no route, direction, or distance signs. The third dimension of altitude, changeable wind drift, and the lack of cloud-borne filling stations complicated matters.

I'd allowed for altitude and wind drift in the flight plan and had studied the course laid out on my chart. Stopping for directions was out of the question; so every 10 minutes or so I had to identify on the ground a check point previously selected on the chart.

Miss more than one of those check points and we'd be lost. If weather turned bad ahead and we wanted to land, we'd suddenly realize that we had no idea of the location of the nearest airport. Turning back would be equally hopeless; for unless we knew where we were "back" could be anywhere.

The squared-off section lines of the Kansas plains gave the country a checkerboard appearance, beautiful to look at but confusing to navigation. Until I learned to use the section lines on a diagonal course, I depended for check points on towns, rivers, and railroads.

Suddenly the checkerboard orderliness ended, and we knew we had crossed the State line into Oklahoma.* When Tulsa appeared on the horizon, we neglected the charts and compass to enjoy the scenery.

The tower operator at Tulsa Municipal Airport didn't know it, but he started an argument when he reported a ground wind of 40 miles an hour, several miles faster than our

* See, in the National Geographic Magazine, "Speeding at Sunset," August, 1957, and "So Oklahoma Grew Up," March, 1961, both by Frederick Simpich.

In a Pilots' Lounge in Atlanta the Author Plots a Course to Mount Oglethorpe

Mr. Mar[illegible] [illegible] of the Appalachian Trail.

landing spot. I knew that wind was going to make it difficult to keep [illegible] on the ground even after a [illegible] landing. [illegible] [illegible] and he was [illegible]. We [illegible] [illegible] and I [illegible].

[illegible] and [illegible] went out and we [illegible]—[illegible] [illegible] the [illegible] would [illegible] [illegible] again.

In the [illegible] I held the ship against the wind with power and brakes while [illegible] blocked the wheels. He then held the tail down while I tied it and the wings to mooring [illegible] covered the controls.

At the Weather Bureau after luncheon I [illegible] [illegible] the weather maps, he said, "I thought you were going to have to [illegible] you down."

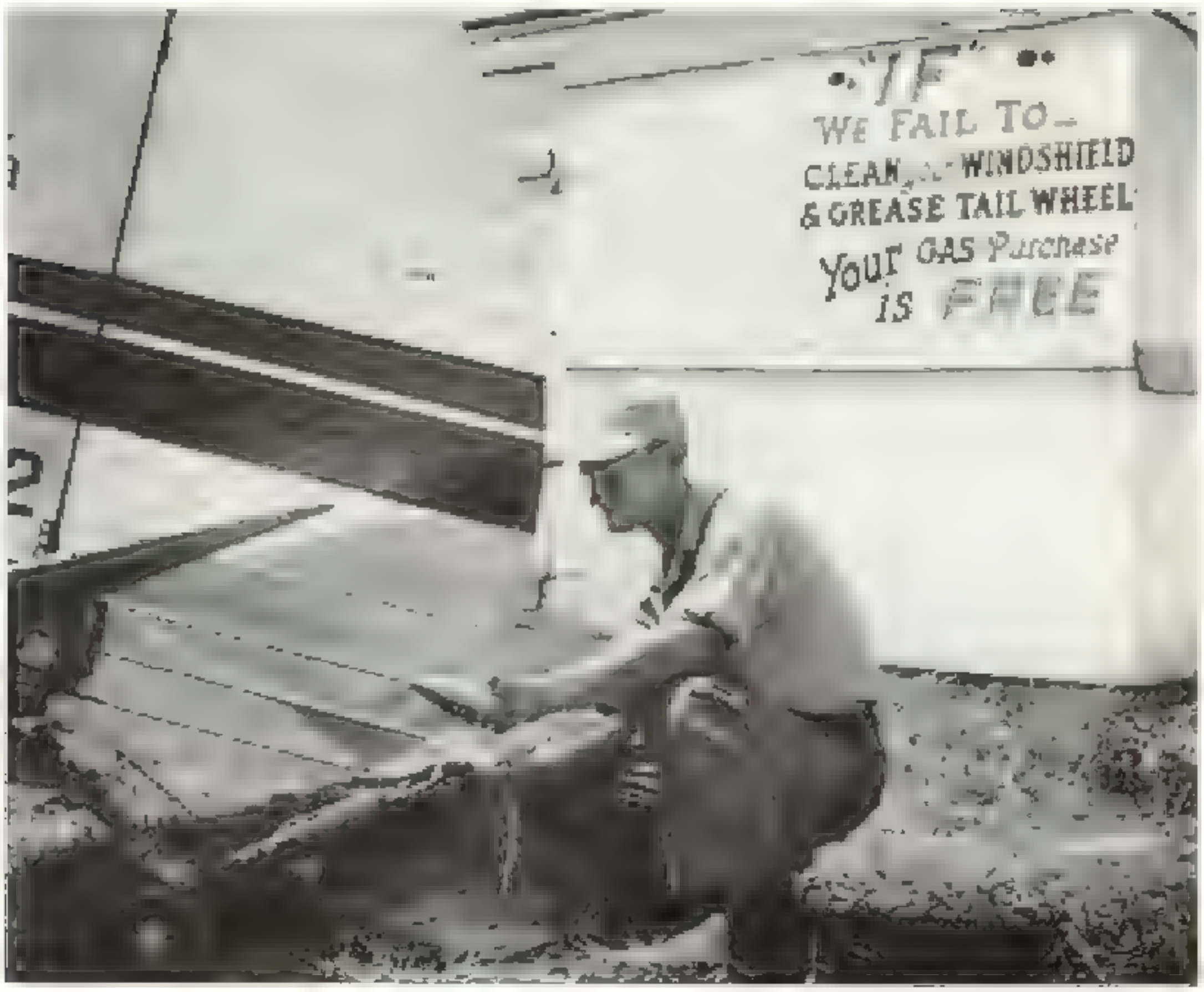
[illegible] afternoon we were over the [illegible] Lake O' The Cherokees [illegible] Oklahoma. [illegible] was [illegible] for more than an hour photographing [illegible] while [illegible] bridges crossing [illegible] the water [illegible]

Landing on Monkey Island

This time there was no argument about landing on Monkey Island Airport, in the center of the lake.

The field was the gateway to a vacation paradise—without a vacant hotel room. Our disappointment must have been obvious, for field owner Merrell A[illegible] offered the use of bunks aboard his cabin cruiser. The landing field was only [illegible] yards from the hangar and the water off the [illegible] we let the [illegible]

[illegible] we discovered that there were [illegible] and were [illegible] for [illegible]



Despite the Sign, He Greased the Tail Wheel and Purged the Windshield!

When the [illegible] Cleveland (page 96), manager of the East [illegible] Mississippi [illegible] he [illegible] after the [illegible] [illegible] the [illegible]

Mr. Andrews laugh[illegible] had had during the evening. [illegible] ished, we realized that neither [illegible] the entire lake [illegible] the past. Mr. Andrews [illegible] control measures used by the Grand River Dam Authority, which [illegible] dam.

We were awakened early Saturday morning by a plane arriving at the Field. It was the first of several that arrived [illegible] ing Tulsa and Oklahoma City businessmen pilots to join their families for [illegible] Mississippi, coming in as we took [illegible] to the Last Sign.

A [illegible] newly installed [illegible] provided such amusing [illegible] we were [illegible] to Mississippi.

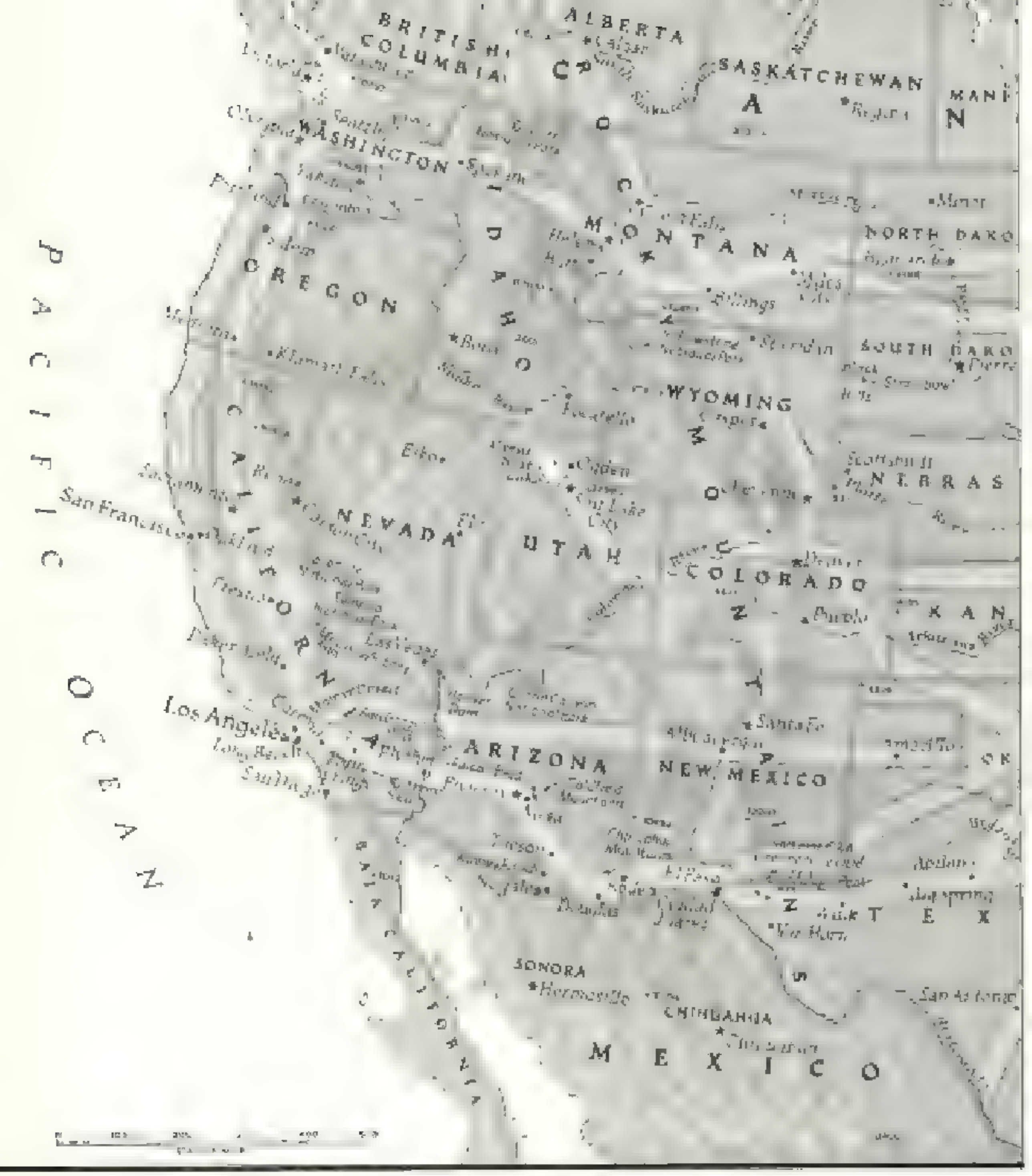
The [illegible] of the [illegible] ing over the [illegible] was suddenly [illegible] of sharp dits, which indicated a special broadcast. Switching over to earphones, we heard [illegible]

We [illegible] and I went to the Weather Bureau to check [illegible] did everything she could, but it was [illegible]

Late on a 'Breakfast Flight'

[illegible] Smith, head of a group of local fliers, telephoned to invite us to join the club on a "breakfast flight" the next morning. We [illegible] when he assured us that he [illegible] for good flying weather.

[illegible] Frederick Stupich

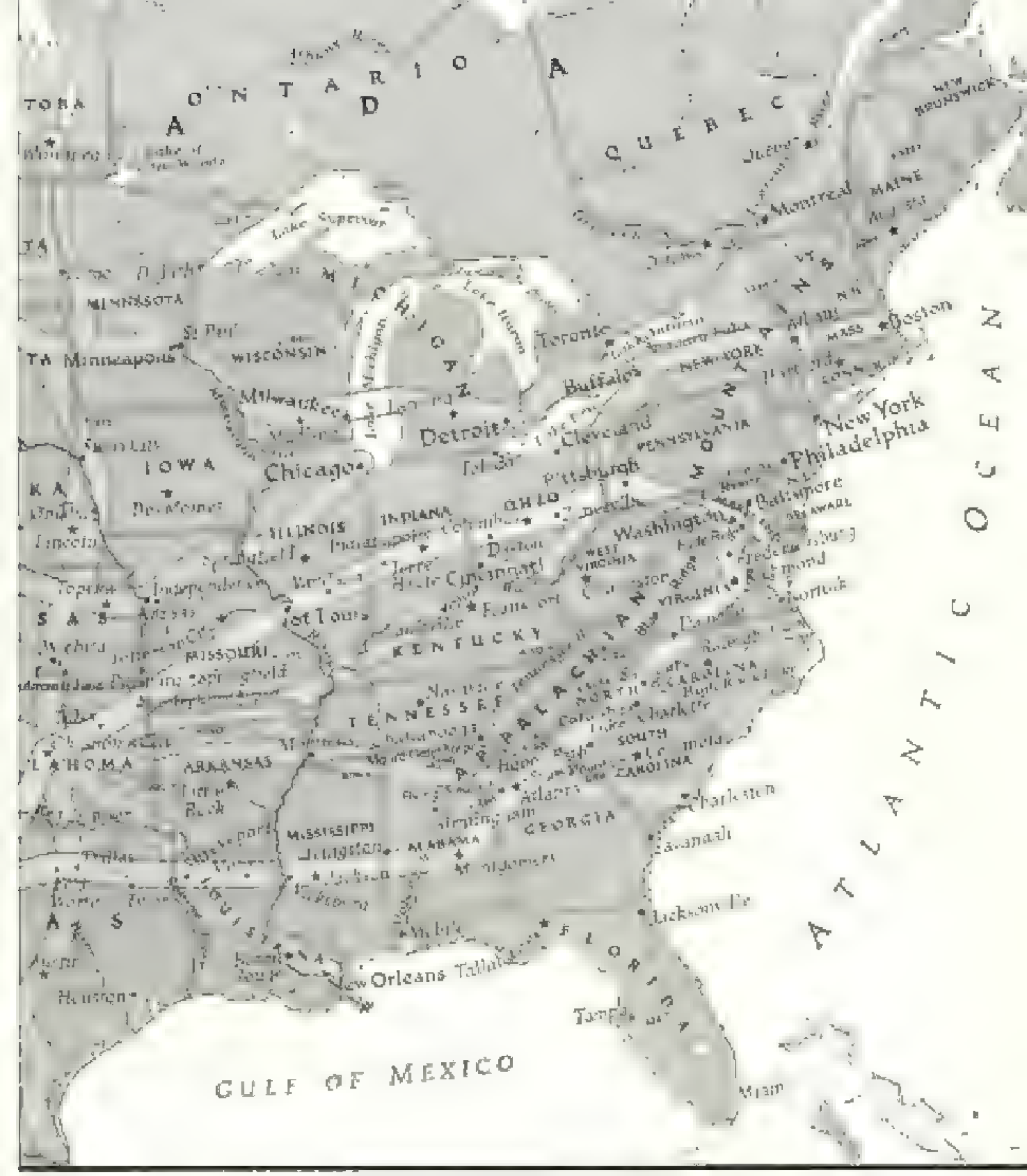


Wright Way (White) Is to Flyers What the Lincoln Highway Is to Motorists

Breakfast was scheduled for 9 o'clock at Pittsburg, Kansas, 75 miles away, and at o'clock found a dozen ships in the air carrying nearly 30 hungry appetites. The others were on time but I got off course and we were late.

Over coffee, eggs, and coffee I took a ribbing from other members of the group with less experience who had made it on time in slower ships. We met several families with small children, two flying farmers, and two men who had been personal pilots for more than 20 years.

Just before we left Springfield for St. Louis the Weather Bureau reported scattered lower clouds at 4,500 feet and a 30-mph head wind below them. Flying in the turbulent air below the clouds would reduce our normal air speed of 125 mph to a ground speed of 95 mph, and we would require more than two hours for the 200-mile flight.



Nine Other Skyways Weave a Network of "Highways" Below the Clouds

I decided to take advantage of a 35-mph tail wind reported to be blowing at 6,500 feet, just above the clouds, and fly a dead-reckoning course with the radio beams for guidance.

With the help of that tail wind we would have a ground speed of 160 mph and be in St. Louis in an hour and a quarter, provided navigation was as good as I thought. Actual ground-to-ground time from Springfield to Parks Metropolitan Airport at East St. Louis, Illinois, proved to be 70 minutes, for a ground speed of more than 170 mph.

We were never out of sight of the ground for more than a few seconds, and the radio range stations kept us informed of weather conditions ahead at 30-minute intervals. Special broadcasts would have warned us of any sudden change for the worse.

This was making flying pay off in a big way, and we were becoming more and more

Zanesville Needs No Aerial Marker, Its Famous "S" Bridge Is Unmistakable

[illegible]

[illegible] Washington to New York. [illegible] there was no proper method of aerial navigation and Mr. Sayre was, from his own experience, [illegible] personal landmarks would have helped.

He recalls that the magnetic compass was the only navigation instrument [illegible] in the pioneering days of air mail. [illegible] Years later, even with modern [illegible] instruments, [illegible] much better aircraft [illegible] over-water flying.

Among [illegible] Washington [illegible] probably [illegible] part [illegible] Sayre's [illegible] that they [illegible] on the roofs of high-pitched [illegible]

[illegible]

and Dayton, Ohio. As we looked down upon the busy countryside below, we wondered how much it had changed since then. Certainly there are now plenty of check points.

Our course paralleled U. S. Route 40, one [illegible] which developed in the wake of the Lincoln Highway. When it was completed, in 1925, the Lincoln Highway became the first marked and mapped road extending from coast to coast. Like the Wright Way, it was planned and developed by an organization of private [illegible] and funds. It did for the private motorist of the day what the Wright Way is designed to do for today's and the future's personal fliers.

Over the Home of the Wright Brothers

Within an hour we were over Dayton, Ohio, home of the Wright brothers and of famous Wright Field, which we could see off to our right as we continued east toward Pittsburgh, still following U. S. 40 and the Pennsylvania Railroad.

Near Pittsburgh the confusion of highways, railroads, and small towns increased to such an extent that contact navigation in the hazy weather became very difficult.

Thanks to a vigorous air-marking program carried out since the war by the Pennsylvania Aeronautics Commission, we found all of the larger towns marked and had no trouble staying on course, even with haze and smoke thick enough to limit visibility to three miles. Towns neither of us had ever heard of will be long remembered for their big yellow air markers.

Pittsburgh was first recognizable as a large area of brown haze, much denser than the blue atmospheric haze to which we had become accustomed. Penetrating that haze to come in over the Golden Triangle was well worth while. Here was one of the sources of America's might (page 117). Spread out over the hills and in the valleys of three great rivers lay the homes, offices, and mills of the people who make the steel for which the city is famous.* Our interest was quickened by the knowledge that some of that steel had gone into our sturdy ship.

Southeast of Pittsburgh, en route to Washington, D. C., we found the Pennsylvania Turnpike climbing into the Appalachian Mountains below us, and took pleasure in our ability to ignore its turns and tunnels and thereby more than double the speed of the racing vehicles on its surface. Itself a chapter in the saga of speed, the highway's broad surface forms a guidepost for the flyer.

The great green mountains unrolled below, and soon we found the Potomac River, with a railroad on each bank.† On one shore was the abandoned channel of the Chesapeake and Ohio Canal, and a modern highway.

From the flyer's vantage point we were looking down on the history of transportation in the New World—trail, river, canal, railroad and auto highway. The river, which had opened a pass for the older forms of transportation, now also serves as a guide for the airplane, the newest.

Before we were clear of the Blue Ridge the tall finger of the Washington Monument appeared on the horizon, and we knew that we should find the city free of its heat haze. Ernie's cameras clicked busily as we crossed over the Pentagon, National Airport, and Alexandria, into Maryland to our home base at Hyde Field near Clinton.

As we settled in for the landing, I caught a glimpse of field manager Chris Martin standing near the landing area, arms akimbo and head to one side. He had a vital interest in that landing, for it was his final approval as flight instructor that had let me make the trip. Chris had further backed his belief in my flying judgment by arranging, through field owner Arthur Hyde, for the loan of Cessna 692.

Chris and ground school instructor Austin Howard had spent many extra hours working out the trip with me (page 97). Thanks to those briefings, many potentially troublesome situations never developed.

A Panorama of History

The southern and western settings of the Wright Way still lay ahead. We were soon in the air again, headed southwest (page 93). The Potomac River was once more our guide, and in 15 minutes' flying over its channel we crossed a whole series of historical landmarks.

On our left, the Maryland shore held Fort Washington and Marshall Hall. The colonial seaport of Alexandria, and Mount Vernon, home of George Washington, lay on the Virginia side.‡

* See, in the NATIONAL GEOGRAPHIC MAGAZINE, "Pittsburgh, Land of Modern Miracles," by John Oliver La Gorce, July, 1952, and "Steel, Master of Them All," by Albert W. Atwood, April, 1937.

† See, in the NATIONAL GEOGRAPHIC MAGAZINE, "Potomac, River of Destiny," by Albert W. Atwood, July, 1945; and "Down the Potomac by Canoe," by Ralph Gray, August, 1944.

‡ See, in the NATIONAL GEOGRAPHIC MAGAZINE, "Washington: Home of the Nation's Great," by Albert W. Atwood; and "The Washington National Monument Society," by Charles Warren, both for June, 1947, and "Home of the First Farmer of America," by Worth E. Shoals, May, 1928.

Wearing the National Geographic Flag, 692 Wings over Washington Bound South and West for California

Skymen Pilots Facing Through Georgia Spotlights Their Position by the Bald Pate of Stone Mountain

[illegible]

Ice-capped Thunderhead and Gray Rain Shroud Are a Pilot's Nightmare

[illegible]

Swinging west to visit the Marine Corps Air Station at Quantico, we followed U. S. Highway 1 into Fredericksburg, Virginia, and then found below us country where air markers would have been helpful.

From Fredericksburg to Danville, with highways, railroads, and [illegible] were our only navigational aids [illegible] were to stay on course. However, I had flown the route before and with the good visibility I was able to identify such landmarks as Burkeville and [illegible] and even saw the home of my brother at Apple Grove.

When we crossed from Virginia into North Carolina, air markers became more frequent [illegible] their tall chimneys and water towers.

High Rock Lake, near Salisbury, [illegible]

strated in full color what happens when water is allowed to get out of control. The water behind the dam was a rich chocolate brown from the silt washed down from farms in the hills to the north and west. We could tell which section had had no rain, for some of the creeks draining into the dam were clear, while others were even darker than the reservoir itself.

Lost on an Unmarked Highway

Five minutes after leaving Charlotte (page 103), we crossed Catawba Lake into South Carolina and were once more dependent upon compass and map alone.

There was a big summer thunderstorm building up on our left, and both of us became so interested in watching it that we neglected navigation. Suddenly I realized that we were away off course.

I was the pilot on an unmarked highway, and I was lost. I'd been lost in the air before, but this was different; I was now responsible for Ernie, who had had nothing to do with it. It was just as well that he hadn't checked out as a mind reader.

Telling myself that I still had gas in the tanks for more than three hours' flying, that visibility was more than 10 miles, and that the ceiling was unlimited didn't relieve that sinking sensation under my safety belt.

Remembering the rules, I continued on the old heading until a fair-sized town showed up below, and then circled it trying to tie it to the chart.

Neither of us could be certain about that one; but there was another a few miles away, so we flew over to try there. Almost immediately we identified Honea Path by its airport, a railroad, a main highway intersection, and large mill buildings on the north side of town, all indicated on the chart.

Getting back on course was a simple matter of working out a new compass heading and flying that to our destination. The thoroughness of Chris Martin and Al Howard had paid off again, but an air marker would have saved us 20 uncomfortable minutes and several gallons of gasoline.

At Villa Rica, a few minutes' flight west of Atlanta, Georgia, Mr. and Mrs. A. H. Stockmar are turning their ancestral home into a personal flyer's paradise. When completed, Flying "S" Ranch will be a worthy rival of any western dude ranch. The main house is built over a partly worked-out gold mine.

Mrs. Stockmar met us with a jeep when we landed and insisted that we stay for a potluck dinner in the kitchen. What a meal! Cold sliced country ham, fried chicken, hot corn bread, green beans, corn on the cob, sweet potatoes, bowls of fresh butter, pickles, relishes, iced tea, and pie!

After such a meal I'd have preferred a hammock under a tree, but instead we toured the mine, the hangars, partly completed tourist-style quarters, and the dam being built to provide a lake for seaplane landings and fishing for guests.

Mr. Stockmar offered me the use of his pet Tennessee walking horse. Flattered, I made the mistake of accepting. That horse was a born Rebel and showed her disdain of a Damyankee flyer by refusing to use any gait but a stiff-legged trot. The others were polite enough to laugh only when they thought I was too busy to notice—which was most of the time.

West of Montgomery, Alabama, we ran into a local thundershower that had grown up to be a full-sized storm, and had to turn off course for a landing at Livingston. The field was small and appeared to be deserted. I dragged over it slowly at 100 feet to check before landing.

As we came around again for the landing, a car turned in off the highway and the driver got out to signal us into the parking area. He was the field manager, who had seen us letting down over town and had left his seat at a Fourth of July baseball game to meet us [illegible] he returned to his ball game, after rigging a window so we could use his phone to check weather before proceeding.

At Hawkins Field, Jackson, Mississippi, I had the thrill of flying a plane equipped with the new Goodyear crosswind landing gear. Landing safely with the conventional landing gear requires extremely careful handling, unless the wind is blowing straight down the runway. A moment's carelessness can result in expensive damage and even serious injury.

Using the crosswind gear, I headed the ship off center of the runway to correct for the wind drift, and a casterlike device inside the wheels [illegible] with the runway when they touched the ground. The new gear requires no extra controls and is so simple that I could use it successfully after a couple of [illegible]

By reducing the number of runways required, this new gear may make possible safer, less expensive airports in many places where there is now no room for them.

A Versatile Airport

Three miles outside Jackson, John Cleveland runs the three-ring circus he calls [illegible] Jackson Airport (pages 87 and 94), Johnny.

"Union Jack" Arfield, Tucked in a Loop of The Meandering Red River, Identifies Bustling Shreveport

[illegible]

Veteran Pilots Huddle with the Author in Last-minute Briefing

To Sample Our Water, a Sonarman Refuels 692 Through a Chemnis

motto is "Service," and he provides it in the form of a good coffee shop and tourist cabins right on the field. If you prefer to stay in town, his service car takes you there without charge.

To add to the fun—and the income—the field has a dirt track for midget auto racing and there was an auto auction in the main hangar once a week. One of the field's small training planes was equipped with loudspeakers and flown over the city to send down music and advertising patter. The morning we were there it was being used to boost a local political candidate.

Both of us became so intrigued with picturemaking at Vicksburg and along the Mississippi River* that our flight plan had to be amended to include an extra fuel stop at Monroe, Louisiana. It was the only time on the trip that we failed to reach our scheduled destination for lack of fuel. We always planned our flights to allow an hour of fuel reserve.

Some minutes west of Monroe, Ernie pointed to the fuel-pressure gauge, which was jittering badly. I'd noticed it earlier and, assuming the worst, a fuel pump failure, had already decided on a landing at the nearest airport. The last check point marked on my running flight log quickly indicated that the closest field was at Shreveport, 15 minutes ahead (page 96).

Cessna had thoughtfully provided an auxiliary gravity fuel system which would keep gas flowing to the engine even if the pump failed completely. But this knowledge didn't prevent us from keeping a nervous eye on that gauge until we had cut the switches in the parking area of Shreveport Municipal Airport.

Next morning I watched while a CAA licensed mechanic blew out of the fuel gauge line a big gas bubble, caused by the high temperatures of the day before. When a test run of the engine on the ground showed that there was still some trouble, we overhauled and cleaned the entire fuel system. It was a wise decision, for there was a tiny crack in a fuel pump part which later might have caused a complete failure.

"Posing" Landscapes for Pictures

When it came to pictures, Ernie was in command, and it was my job to put the ship where he wanted her, within the limits of safety and Civil Air Regulations. Usually he wanted her lower, slower, and closer, but the summer clouds west of Shreveport grew so fast he kept calling for more altitude and more distance to get them in his camera field.

The distance wasn't hard, but no small ship could have got above those clouds. We were more than two and a half miles high and shaking with cold when he gave up. The thermometer was down to 35° F., and we'd been too busy to think of the cabin heaters. Neither of us realized at the time that we were feeling the prolonged lack of oxygen, [illegible] to, indicate that I was.

Since our leaving Washington, weather reports and the weather had been almost monotonous—high overcast, scattered lower clouds, visibility 10 miles with haze, winds west, 10 to 15 mph. As we crossed east Texas, a change became apparent. Visibility and wind velocities increased; haze and thunderstorms decreased. We saw our last thunderstorm at Tyler.

West of Dallas and Fort Worth, the fertile blacklands began to disappear as the ground steadily rose to the high, dry plains of the cattle country.†

Ranch Houses Serve as Check Points

At Abilene the desert areas began to appear, and good check points came at wider intervals. They were, however, easier to see and identify. In some sections an isolated ranch house was important enough to be marked on the charts.

Tank farms, oil well derricks, and the huge gas flares of the refineries dotted the landscape. Small airplanes flew along below us, checking the pipe lines which cross the desert in all directions.

Darkness brought us down on the Wink Municipal Airport [illegible] Here we found the field manager, Wesley L. Stoddard, using a National Geographic map of the United States as an aid to students planning cross-country flights.

We had a graphic demonstration of the clarity of desert air when the Sacramento Mountains appeared on the horizon more than 80 miles away. When we reached them, 40 minutes later, the weather station near Guadalupe Peak, highest point in Texas, was reporting visibility at more than 150 miles. Flying at 10,000 feet, 5,000 feet above the floor of the pass, we were in smooth, sparkling, clear air.

Minutes later, as we descended to land at Salt Flat CAA Intermediate Field, the desert-heated air was so rough that our vertical

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Down Mark Twain's River on a Raft," by Rex E. Blossomgame, April, 1946; and "Machines Come to Mississippi," by J. R. Hildebrand, September, 1937.

† See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Wild of Texas," by Frederick Simpich, February, 1943.

Like a Motorist at a Model, the Author Parks (at Rear) His Canoe on a Mississippi "Skyway"

From 1,500 Feet, Southern California's "Circle City" Looks Like a Plane Geometry Problem

After San Gorgonio Pass, Seaway Flyers "Hit" This Target on the Way to Los Angeles

speed varied from 1,500 feet a minute up to the same amount down a second later. On the ground, at 3,700 feet above sea level [illegible] in the sun—there was no shade. The mountains all around the field seemed to dance behind the curtain of heat waves.

About a dozen Department of Commerce employees and their families live on and operate this lighthouse and harbor in the desert. Diesel-driven generators supply power [illegible] light [illegible] instruments, and lighting. A windmill pumps water, and the homes and work spaces are made livable by small evaporation-type air-conditioning units.

A small restaurant caters to tourists on near-by Route 62, but there is no school and until recently the post office was at Van Horn 70 road miles away. We were the first aerial visitors in more than two weeks.

El Paso, Texas, is a busy modern city, spiced with the speech, dress, and confidence of the Texans. The early Spanish explorers called it El Paso del Norte, "Pass of the North." Modern-day tourists have made it a "Pass of the South," for it is a port of entry into Mexico. Just across the block-long International Bridge is Ciudad Juarez, in the State of Chihuahua. It, too, is a busy modern city, but as different from El Paso as if it were in another hemisphere.

We stepped off the bridge to Avenida Juarez into a mixture of Atlantic City Boardwalk and Coney Island Midway, seasoned with chili pepper and Spanish architecture. It is a paradise for souvenir hunters, art collectors, and shoppers, and business is conducted in English or Spanish, dollars or pesos. The rule is, Buy if you like—but bargain you must. It is unthinkable to pay the asking price; doing that would break up the game.

Mexican Lunch "of Heroic Size"

Restaurants, juke joints, and plush-lined floor-show clubs provide either Mexican or American food and drinks at prices that make tipping unnecessary. I had a cocktail and a Mexican lunch of heroic size for less than $2.

On the Calle 16 de Septiembre, in the center of the business district, are the 17th-century Mission Nuestra Señora Guadalupe and the futuristic façade of a luxurious motion-picture theater. Back of the mission are modern steel-and-stone government buildings and an up-to-date market. An occasional burro cart shows the heavy stream of autos, trucks, and buses.

Except in the residential districts with their Spanish-style homes, contrasts are the rule. Juárez and its people are unmistakably Mexican, but not the Mexican of song and legend. They work and play as hard as any Yankee, and seem to enjoy it more.

Returning to El Paso was as easy as leaving it for Erie. Each time he just walked through customs, while I had to stop and prove my citizenship. The fourth time I was annoyed enough to ask why I was always *it*.

"Don't blame me, mister," said the customs inspector. "I'm just doing my job. You're sunburned the same copper color as some of these Indians, and a lot of them have blue eyes and blond hair, too. You just don't look like an American to me."

The sparsely populated border country of New Mexico and Arizona, from El Paso west to Tucson, is the driest and most mountainous section of the Wright Way. A forced landing there could be serious. Chances of trouble in the air were slim, but I followed the advice of seasoned desert pilots and filed a detailed flight plan with the Air Traffic Control Center at El Paso.

I prepared the plan for this run exactly as I had all the others, and then reduced it to the standard sequence required for filing by radio after take-off. When I had established contact with El Paso Radio Range Station and told what I wanted, my earphones said, "Cessna six-nine-two, this is El Paso Radio. Proceed with your plan. Over."

I answered: "El Paso Radio, this is Cessna six-nine-two. Here is my VFR (visual flight rules) flight plan. NC four one six nine two, Cessna one seven zero, Markwith, Anderson Field, 10,000 Green 5 Tucson, one two five, three one zero five, oh nine twenty, eleven forty-five, four point five. This is Cessna six-nine-two. Over."

After repeating back to me, the communicator told me he would accept and file the plan. He then relayed it to Air Route Traffic Control Center, where a dispatcher put the exact sequence on the teletype circuits to Tucson and all the radio range stations between.

Translated, that sequence meant that NC [illegible] Markwith, would leave Anderson [illegible], El Paso, to fly at 10,000 feet, along Civil Airway Green 5 to Tucson, Arizona. The plane would fly at 125 mph, transmit on a radio frequency of 3,105 kilocycles, depart at 9:20 a.m., arrive at 11:45 a.m., and carry enough fuel for four and a half hours of flight.

If we failed to terminate that plan before 2 p.m., when our fuel would be gone, all the organized machinery of search and rescue would automatically go into action to find us.

No Place for a Backseat Flyer! 602 "Stakes Downdraft" to Land at Charlotte, N. C.

The plane is gliding down a 60-foot "duff" of air at 11 [illegible] in the [illegible] Not flown and airplane [illegible] Here the plane [illegible]

We [illegible] the [illegible] plan, we could not be [illegible] and even then [illegible] south.

Clouds Cause Detour

[illegible], New Mexico, the Wright Way [illegible] southwest to Douglas, Arizona, to avoid the Chiricahua Mountains [illegible] Airway takes a more direct route [illegible] to Tucson, and I planned to follow it instead of the Wright Way. [illegible] we would be perfectly safe and save time and fuel.

But when we arrived at Douglas we found [illegible] a mantle of clouds which [illegible] the [illegible]—[illegible]. A brief discussion [illegible] with the Airport Manager [illegible] Bureau of Air Commerce Field [illegible] amended the [illegible] from Airway to Wright Way, [illegible] for Douglas.

The [illegible] the [illegible] plan to Tucson to [illegible].

Though we were [illegible] late arriving in Tucson, we had [illegible] in three hours [illegible] in the [illegible]. A [illegible] trip [illegible] by car gave us a [illegible] respect for the people who had made the trip [illegible].

Returning from our [illegible], we stopped to cool off in the swimming [illegible] at Kinsley, Kansas. [illegible] for breeding and [illegible] stock for the Nation's [illegible] [illegible] Kansas [illegible] driving and [illegible] traveling. Owner Otho Kinsler and his sons have built a better mousetrap.

In the [illegible] Great Bend, [illegible] and for many [illegible] miles and [illegible] has built a large lake to store the water from the deep well. We [illegible] good. As soon as the lake [illegible] stocked [illegible] fishing, [illegible] gets out [illegible].

Skippers Seal Tiny Vicars' Nest Subs, 40 Fathoms Below the Pacific—on California's Salton Sea

Above Santa Monica's Famous Beach the Flyers, Like Balboa "Silent upon a Peak in Darien," Discovered the Pacific

pelicans arrived to show the fishermen how it's done. The wheeling flock of sea birds stood out in sharp contrast against the background of desert and mountains, more than 100 miles from salt water.

Ten minutes after the passing of a mountain cloudburst, the road and the desert appeared as dry as ever, but a miracle had been performed. The gray desert now sparkled with green, and the mountains glowed with brilliant colors. The heat was gone, and we drove along under a flaming sunset that lasted nearly an hour. The play of colors changed so rapidly that only a motion-picture camera could have captured them.

Desert Plant Flares into Lighthouse

Some steers outlined against the sky refused to wait for Ernie to make their portraits, so I set out on foot to drive them back into position. They drove easily—anywhere but back. When they were tired of me, they just faded into the brush, leaving [illegible] cacti—could be admired from a safe altitude.

Paul Nichols, Chief Pilot at Falcon Field, was our guide on a trip into the Goldfield Mountains. This was the desert of the tall saguaro* and the wickedly beautiful cholla cacti. Every plant we saw grew thorns of some nature.

Paul cautiously ignited a cholla plant to demonstrate its usefulness as a sort of desert lighthouse. Hunters lost on the desert after nightfall use its brilliant, lasting flame to guide searchers.

Near Mesa, Paul showed us bank-full irrigation ditches which had been built by the predecessors of the Pima Indians.†

The [illegible] industrious Mormons who founded Mesa in 1878 repaired and enlarged the ancient irrigation system to provide water for the rich date-palm and citrus groves which surround the city today. From the air, Mesa appeared as a fairy city in the midst of its man-made oasis.

Smaller oases dotting the area were the sites of the luxurious wintertime guest ranches which surround Mesa and Phoenix.

The large irrigated area along the banks of the Colorado River near Blythe, California, presented another sharp contrast to the barren mountains and scrub-covered desert. The downdraft caused by the cooling effect of the green area gave us a real jounce as we crossed its borders.

As we approached, clouds completely obscured the 10,000-foot-plus peaks guarding each side of the sun Gorgonio Pass. After Indio Radio had assured us that the lowest of them were 3,000 feet above the floor of the pass, we entered it and found ourselves flying in a sort of tunnel.

Below was the 2,000-foot-high floor of the pass, on each side the steep, chocolate-colored slopes of the mountains, and, above, the ever-changing clouds for a ceiling. Soon our tunnel widened into a valley, and we were out in clear air north of March Air Force Base.

Ahead a curtain of brown smog hung from the lower peaks right down to the ground. The charts said Los Angeles was under it, and the radio kept insisting that I could see through three miles of it. When a flight of jet planes burst out of that haze ahead, I knew we were going to stay above it as long as possible. Sure enough, the outlines of greater Los Angeles appeared below, and we cautiously glided down to land at Central Airport.‡

Daily plane traffic at Central is heavier than that at Los Angeles Airport. It was the only privately owned field we found using a radio-equipped control tower. The heavy traffic of visiting planes is probably due to the many services available.

In addition to service for the plane, the field provides radio-equipped sleeping quarters, a restaurant, and a cocktail lounge. The office will rent you a car, or have your laundry and dry cleaning done in 24 hours. It will also reserve your hotel room, receive and forward your mail, and furnish you with the latest weather report.

While Ernie was busy with his cameras on the ground, I worried the Weather Bureau and the Chamber of Commerce about weather for aerial photography.

When the go-ahead came, we started at Cahuenga Pass and worked west over Beverly Hills and the Santa Monica Mountains to the coast at Point Dume. Returning, we flew east and south along the coast (page 105) to Palos Verdes Point and then over to Long Beach.

Mountains, Sea, and City

Heading north again, we found the incredible natural setting of the area spread out in all its glory. The contrasts of mountains, sea, and city made it easy to understand the

* See, in the National Geographic Magazine, "Saguaro Cactus Camel of Arizona," by Forrest Shreve, December, 1945, and "Saguaro Forest," by H. L. Shantz, April, [illegible]

† See, in the National Geographic Magazine, "Seeing Our Spanish Southwest," by Frederick Simpich, June, 1940.

‡ See, in the National Geographic Magazine, "Southern California at Work," by Frederick Simpich, November, 1934.

692 Sails Through Customs and Immigration on the Mexican Border as a "Ship"

[illegible] motorcars, planes entering the United States are classed as ships. [illegible] Mexico [illegible] Nogales Airport [illegible]

pride the natives take in their homeland.

A report of perfect weather in the San Gorgonio Pass caused us to check out of our hotel hastily and head back east. The towering peaks of the San Bernardino and San Jacinto Mountains so near at hand were that charts and flight plan were quickly discarded in favor of the scenery. Emile soon had me flying in great circles while he tried to capture as much as possible on film.

The intense heat [illegible] to meet us from Palm Springs Municipal Airport made us [illegible] the [illegible] famous winter resort—in winter.

The [illegible] a sort of holding pattern during the hot months. Everyone who can leaves for cooler climates; those remaining stay indoors during the middle of the day. Air conditioning is as usual as heat in a Government building, and shopping and sightseeing, swimming pools [illegible] the most active business in town.

Living-room Swimming Pool

When she learned that the pool at our hotel was closed [illegible] Mary Nelson [illegible] the living room in her home in the desert. We stepped from the [illegible] the

pool, and if we had climbed out at the other end we should have stepped into the cactus-covered desert. A backdrop of mountains shimmering through the heat completed the wide range of contrast so common in California.

Taking a personal plane into Mexico can involve endless time and red tape, but not at International Airport, Nogales, Arizona (page 107). Here border authorities of both countries cooperate to reduce immigration, customs, and health requirements to a single painless operation. Nogales businessmen credit airport manager Jack Evans with the innovations which have resulted in international visiting at the rate of 2,000 personal planes a year.

Exploring Sonora's Capital

Declaring Ernie's foreign made cameras and obtaining Mexican flight plan and tourist permits required only a few minutes in a small section of the field office. With my receipted airport statement, which included all border fees, Mr. Evans gave me a list of Americans living in Sonora and a schedule of Mexican hotel, taxi, and gasoline rates. He also provided Mexican currency at the going rate of exchange.

On arrival at Hermosillo, capital city of Sonora, we piled our gear in an air-conditioned hotel room and set out to explore. The city presented many fine examples of the progressive planning and active development for which the whole State has become famous. A large American-designed cement plant has provided the material for an irrigation dam, State University buildings, a museum and library, and many homes and office buildings of ultramodern design.

The strong emphasis placed on education was, I thought, aptly demonstrated by placing the elementary and secondary schools as close as possible to the University campus. Even after learning that English was a required subject, I couldn't get used to having 10-year-olds answer my horrible Spanish in fluent English.

Ernie's Spanish was more than adequate—until he tried to order breakfast eggs "sunny-side-up." Finally he drew a picture while I made motions in favor of scrambling them. It worked so well that we never learned the proper terms.

Diagrams and gestures would not work over the telephone, so the hotel clerk put through my call to Nogales to give American customs the required notice of arrival.

The only other formality required was permission to take off (page 97).

The airport manager instantly granted this and we set out on a speed run for home. A bit of figuring after landing at Big Spring, Texas, that night showed that we had covered 730 miles, over three States and two countries, in less than nine hours. Five hours and 40 minutes was actual transit time. Customs, a leisurely luncheon, and aerial photography accounted for the rest.

Another four flying hours brought us down on Cessna Aircraft Field at Wichita to complete the round trip. In less than 46 flying hours we had safely covered 5,030 miles over mountains, deserts, and farmlands, in 20 States, Mexico, and the District of Columbia.

Weather delays amounted to less than 5 days out of 53. Operating and maintenance costs of $5.80 were about the same as they would have been for a medium-priced car carrying the same load.

Looking back, we found that, where available, air marking had provided a positive link between ground and chart. In planned sequences it had speeded flight planning and increased ground speed by simplifying navigation. Because they were so hard to find, big-city markings had not been important, but small-town markers had been invaluable. A surprising number of airports had been unmarked.

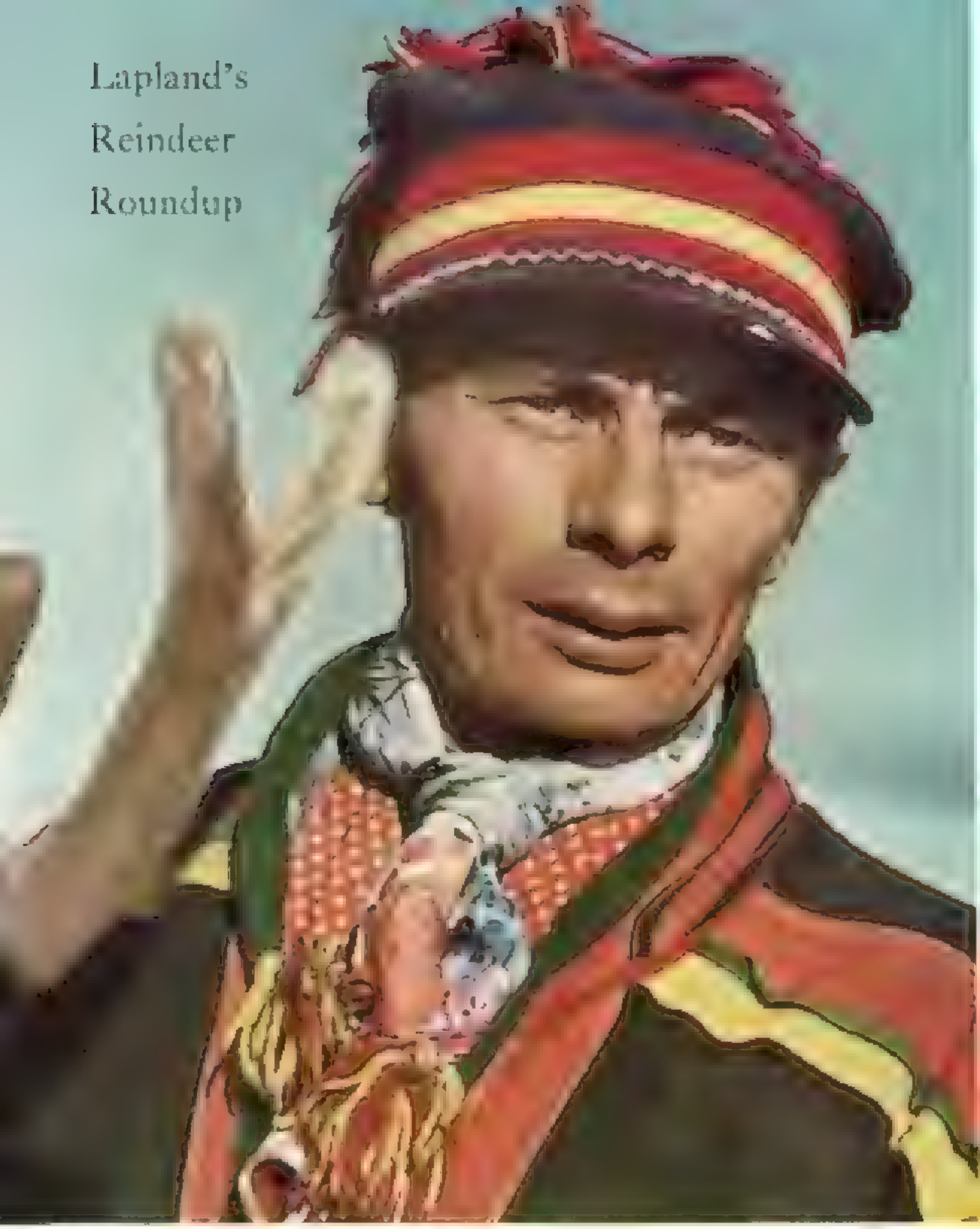
Skyways Make Flying Safer

While much remains to be done, the Wright Way and its sister Skyways mark another long, forward step in the growth of personal air transportation.

With a relatively small amount of training and plenty of respect for the weather, Mr. Average American will be able to navigate his personal plane along the Skyways as easily and safely as he now navigates a well-marked surface highway in his car.

[illegible] Be sure to include your postal-zone number.

Lapland's Reindeer Roundup



Stern-faced Lapp or Velvet-antlered Reindeer—Which Is Truly the Master?

Armies Clash at Fall Roundup, Earth Rumbles Beneath Thudding Hoofs . . . A Deer Roper Uses His Back as a Hitching Post

[illegible]

Lapp Herdsmen Usually Cowboys Work on Foot, Yet They Are Equally Skillful Rarely Missing a Lasso Cast

Women's Lot in Lapland Is Hard Work: She Hangs Out the Laundry and Milks the Obstinate Reindeer

[illegible]

Baby Sitter Minds Brother Beside the Summer Tent

Stiff Shirts and Stockings Create a New Look for Mamma

Fear Gleaming in Her Eye, a Mulish Doe Refuses to Bridge. Her Owner Advances Hand over Hand on His Lasso

[illegible]

Lapps Prosper in Hardship Because Reindeer Is Their Medicine

[illegible]

Baby Is Swaddled Like a Mummy — Bystander Observers Jealously

[illegible]

Coffee Blower Puffs Out His Cheeks — to Blow in Face

[illegible]

Pittsburgh: Workshop of the Titans

By Albert W. Atwood

With Photographs by Nathan Benn, George Pfrommer, B. Anthony Stewart, J. Baylor Roberts, and John E. Fletcher

One M.E. [illegible] so dependent upon natural resources, especially upon mineral resources, as Pittsburgh, world capital of coal and steel.

As the throbbing heart of basic, heavy industry, and the very symbol of America's industrial power, there is something elemental about Pittsburgh. It is direct, natural, vibrant, and virile. It has restless, dynamic drive. It has fundamental strength, like steel, of which it is the world's No. 1 producer (page 123).

To an unparalleled extent, Pittsburgh is a city of producers, and by contrast many other cities seem like mere market places.

Underlying the greatness of Pittsburgh, both literally and figuratively, is the so-called Pittsburgh seam of bituminous coal, found throughout so much of western Pennsylvania and West Virginia. This is one of America's chief sources of energy and is generally considered the world's most valuable single mineral fuel deposit.

Other seams of coal, both in the United States and abroad, are thicker and more extensive; but there are relatively few from which coke for steel manufacturing can be made and an even more limited number whose location so perfectly fits the needs of industry.*

Set in a Circlet of Ridges

Pittsburgh's location, plus its nearness to coal, has made it a City of Industry. Within a 500-mile radius is more population and probably greater riches than in such a circle drawn around any other metropolis in North America.

Like most big cities, Pittsburgh is located at a natural break or junction in transportation routes. With some cities it is the mouth of a river or the end of a lake; in the case of Pittsburgh it is a junction of river valleys.

Indeed, Pittsburgh exists because two great rivers, the Allegheny and the Monongahela, come together at the "Point," or apex of the city, to form the Ohio.

The result is a marvelous system for the collection and assembly of vast quantities of bulky raw materials, such as iron ore, limestone, coal, and coke to make steel. Transportation is supplied by fleets of barges on three rivers and trunk-line railroads along their banks.

Like New York and San Francisco, Pittsburgh has a spectacular setting, a capacity for being seen with the eye in the large. Its location has great natural beauty as well as colossal utility.

But alas, it is handicapped as well as blessed by topography, for it occupies one of the most irregular and uneven sites of any upon which a great city is built (page 126).

"Pittsburgh is undoubtedly the cockeyedest city in the United States," wrote the late Ernie Pyle. "Physically, it is absolutely irrational. It must have been laid out by a [illegible]

A Mountain and River Town

Seriously, it is to all intents and purposes a mountain as well as a river town. A local geographer says that 10 percent of its surface is in slopes of 40 percent or more. The lowest elevation, at river level, is above 700 feet, and the hills with which the city abounds rise to more than 1,200 feet, many of them steep, barren, and unfit for habitation.

Because of the mighty force exerted by the three rivers through the ages, the Appalachian plateau at this point is eroded and dissected into a maze of irregular hills and sharp valleys or ravines, some deep and narrow.

One is amazed that human beings should build in such a place. It is a city of isolated settlements and communities, many of whose residents rarely visit other sections, for natural barriers make travel awkward, difficult, and circuitous.

"You may have a friend who lives half a mile away," to quote columnist Ernie Pyle again, "But to get there you circle three hills around a mountain ridge, cross two bridges, go through a tunnel, follow a valley, skirt the edge of a cliff, and wind up at your friend's back door an hour after dark."

However, because of its extraordinary topography, the average visitor to Pittsburgh sees scarcely a dwelling in it, and probably the only steel mills he sees are before he reaches it or after he has left.

The lack of level land has forced a large majority of the basic industries up the Alle-

* See in the National Geographic Magazine "Coal: Precious Wealth for Man," May, 1944, and "Steel: Master of Them All," April, 1947, both by Albert W. Atwood.

Magic Radar Guides Towboats Through Fog and Darkness on Pittsburgh's Rivers

[illegible] the captain [illegible] the pedals of navigation where "pea soupers" blanket the [illegible] Through the pilothouse window may be seen the tug's coal-laden barges [illegible]

[illegible] and Monongahela, almost without a [illegible], for distances of 40 and 25 miles, respectively, and [illegible] for a distance of [illegible] miles. Pittsburgh is the heart of an industrial empire [illegible] spread along the banks of [illegible] into many other communities.

First Settlement at Fort Pitt

Pittsburgh was [illegible] settled in the [illegible] vicinity of Fort Pitt, at the confluence of the two rivers.

As the [illegible] pushed along the river valleys they [illegible] most of the level [illegible] and [illegible] bottom lands were taken up by the immigrant hordes who came to work in the [illegible].

Those who [illegible] to [illegible] west [illegible] the [illegible] of [illegible] resolution [illegible] of coal [illegible] to [illegible] smoke [illegible] more attractive surroundings.

[illegible] the downtown [illegible] of a [illegible] and

known as the Golden Triangle. It is one of the most [illegible] business districts in the world (pages 120 and 121).

Here are the [illegible] of leading [illegible] banks, hotels, theaters, [illegible] and [illegible] newspapers, restaurants, office buildings, [illegible] the [illegible] corporations, [illegible] and department stores.

[illegible] people [illegible] the [illegible] of the Golden Triangle. For Pittsburgh is a [illegible] covering [illegible] northwestern Pennsylvania. It is the [illegible] of a [illegible] population area [illegible].

Allegheny County, of which Pittsburgh is the seat, has 129 [illegible] boroughs, [illegible] townships.

Pittsburgh is one of the few large [illegible] where [illegible] and [illegible] contiguous communities on a large scale, but there are no [illegible] or [illegible] boundary lines [illegible] community melts into another.

Trade in the Golden Triangle

Even the most usual [illegible] in the Golden Triangle [illegible] by the size and [illegible] of the department [illegible] because everybody comes to town to [illegible].

Her Job Calls for Gen. She Inhales Dust-Filled Air to Aid Science

[illegible]

Three Rivers Frame Pittsburgh's Golden Triangle, Seat of American Industrial Might

On the point where the Allegheny (left) and Monongahela merge to form the Ohio, Fort Pitt, forerunner [illegible] Island—was built in 1759. Through tunnels, across bridges, along cliff-clinging [illegible] to work, shop and play in the Triangle's compact mass of steel and [illegible] Egyptian pyramid crowns the 41-story Gulf Building, the city's tallest, which [illegible] petroleum empire. Hill's across-the-street neighbor houses headquarters [illegible] Company, Inc., whose products range from poison gas and plastics to railways and coal mines. In an average month, barges plying the rivers haul more tonnage than passes through the Suez or the Panama Canal.

[illegible] stores and relatively few specialty shops as compared with many other cities.

On Monday night, from scores of coal-mining and steel mill towns, the miners and mill-workers themselves, as well as their wives, come in to town. The great stores cater to every economic group and all classes [illegible] home in them.

Thirty years ago the department stores began to build up departments as if they were specialty shops—junior misses, beauty parlor, gifts, ready-to-wear, and the like.

In no other large city does this type of store do such a large proportion of the total retail business.

But how can such a trade of people be [illegible] in and out of the Triangle in a [illegible] In addition to those who drive their own automobiles, who use the trunk-line railroads and the more than a dozen independent bus lines, approximately 350,000 are [illegible] by the Pittsburgh Railways Company.

In most cities I have taken streetcars for granted, but not in Pittsburgh. Here no separate streetcar routes enter and leave the small Triangle. Outside of it a map of the lines looks like the bad dream of a modern artist.

Confused and Complex Street Plan

For one thing, the street plan itself is necessarily confused and complex. Streets come to a dead end in hillsides, and in the different sections of the city they do not run according to the points of the compass, but at right angles or parallel to the three rivers.

Then, too, most of the lines cannot proceed directly through paying territory, but must follow very indirect routes, around, over, or through an unproductive area or barrier of barren hills, to reach spots flat enough for residential settlements.

Once Backwoods Fort Now Rules World of Coal, Steel, Glass, and Aluminum

[illegible]

[illegible]

Dandelions Carry Millions

[illegible]

In a Midget Laboratory, Lilliputian Experiments Help Control a Gulliver Industry

[illegible]

[illegible] the river, the bridge being 1,500 feet long and rising 700 feet from the bottom to [illegible]. [illegible] it.

Pittsburgh and the communities near it could not exist, of course, without hundreds of bridges. It has, perhaps, more bridges than any other city in the world.

A City of Bridges

The county and city together have more than 1,500 bridges. Not only must the rivers be bridged in many places but so must many ravines and valleys.

Naturally, [illegible] in [illegible] for [illegible] the matter of life.

New bridges [illegible] than the old ones and [illegible] room for [illegible]. The new [illegible] Street Bridge is 2,[illegible] feet in length, replacing one of 1,[illegible], the difference in length being due to longer approaches [illegible].

Descending the Monongahela River in a launch, I was struck by the sheer number of bridges, railroad and industrial as well as highway. Their frequency [illegible] itself.

Noteworthy among them are the "hot metal" bridges, used exclusively for the carriage of carloads of molten iron and steel between two plants of the same company.

Most of the great industries in the Pittsburgh district could not exist on their present scale without the rivers, which supply transportation and essential water for cooling purposes. In fact, the entire flow of the Monongahela [illegible] Crescent [illegible].

Except during [illegible], the flow of the rivers is regulated and [illegible] the year round, [illegible]

[illegible]

Even a Bessemer Must Learn Steelmaking the Hard Way

[illegible] Henry Bessemer [illegible] Homestead plant of Carnegie-Illinois Steel Corporation, where he worked between [illegible]. After graduating from Carnegie Tech, he was employed by a Cleveland subsidiary of United States Steel [illegible].

of Steuben[illegible]. The main [illegible] and [illegible] operated by the Army Corps of Engineers. For example, the port of Pittsburgh [illegible] on the [illegible] Pool, its water level controlled by the Emsworth Dam.

Some[illegible] to the lock and dam system might prove a national disaster, for it would close the steel mills by depriving them of water. [illegible] I saw the barge [illegible] to the lock by a tow of barges whose pilot, in the dense fog [illegible] the [illegible] of [illegible] of steel rail for his own [illegible].

"The Busiest Little River in the World"

The Monongahela, or "Mon," is perhaps the busiest little river in the world, because more than 27,000,000 tons of coal move upon it each year. A single one of its mills, the Clairton Works of the Carnegie-Illinois Steel Corporation, uses nearly one percent of all the coal mined in the world.

A coal tow usually consists of 1[illegible] barges, [illegible] 900 tons or [illegible] compared with [illegible]0 tons in a railroad freight car.

Navigation on these rivers [illegible] modern, [illegible] of the boats [illegible]. The captains and pilots seem like trim young [illegible]. Former State Senator William B. Rodgers [illegible] for [illegible] of [illegible] and [illegible]. [illegible] were [illegible].

In 175[illegible] the youthful George Washington described the Monongahela as "extremely well designed for water carriage [illegible] a [illegible]-

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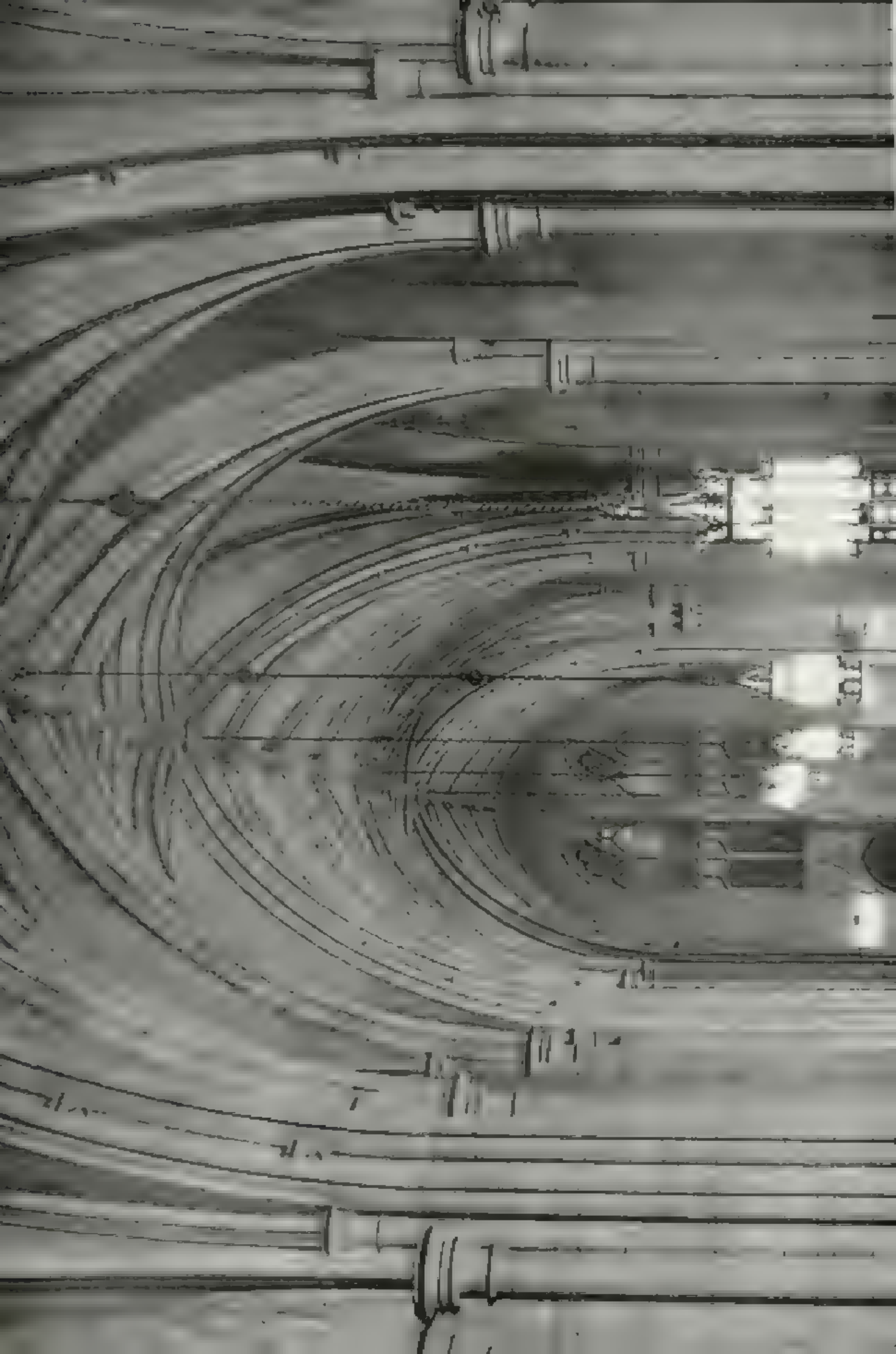
[illegible] Joseph [illegible] National Geographic Magazine, January, [illegible].



Under Soaring Gothic Arches University of Pittsburgh Students Work and Relax in Hut Built near "Indian Campus"

[illegible]

Hillside Houses Stand on One Another's Shoulders, as if Jostling for a View of Pittsburgh's Roaring Steel Mills

From Pittsburgh Schools, Carnegie Institute Selects Promising Art Students for Special Training

[illegible] Architecture are members of the Carnegie Faculty. Assistant Frank Walc[illegible]

They Supervise Pittsburgh's Famous Collection of Prehistoric Animals

[illegible]

"Smoke Sleuths" Work Constantly to Combat a Pittsburgh Nuisance

[illegible]

Pitt University Students Learn How to Arrange a Window Display from Horne's Experts

[illegible] Here [illegible] Golden Triangle [illegible] the Point [illegible] photograph [illegible] The Horne [illegible]

the Allegheny as well, for he was used [illegible] when camped upon a hill [illegible].

The only navigable stretch of the Monongahela is being improved 15 miles [illegible] new [illegible] of [illegible] coal in West Virginia, and an extensive system of [illegible] reservoirs on tributary streams is expected to reduce future flood damage. In 1936 the water rose 11 feet in Horne's department store in the Golden Triangle.

It is a mistake to think of Pittsburgh only in terms of coal and steel, even though these are the city's underpinnings. Here are the home offices of the world's largest manufacturers of many other important products—including aluminum, certain types of glass, [illegible] plumbing fixtures, [illegible] and heating equipment.

One of the largest manufacturers of electrical equipment, one of the largest oil companies, and, curiously enough, one of the largest food manufacturers are located here.

Although [illegible] which aluminum is made [illegible] Pittsburgh [illegible] the Aluminum Company of America, [illegible] the largest [illegible] has always had its home office here and one of its largest fabricating plants.

Aluminum's 60th Anniversary

On October 1st, 1948, Pittsburgh marked the 60th anniversary of the founding of the aluminum industry in the [illegible] section of Pittsburgh. The original furnace is still standing, but a reproduction of [illegible] was erected recently.

Arthur Vining Davis, chairman of the board of directors of the company, who is now in his 82nd year, celebrated the [illegible] by pouring an ingot at [illegible] once again.

Although members of the Mellon family have long been large stockholders in the [illegible]

Carnegie Tech Teaches Future Printers How to Design Advertising That Sells

[illegible] Sterling (left), flanked by Mitchell [illegible] Carnegie Tech is the country's only college giving a degree in [illegible] typography, composition [illegible] and design [illegible]

[illegible] Mr. [illegible], who, fresh out of college, bought the first [illegible] of the [illegible] company [illegible] and is known in the industry as "Mr. [illegible]."

[illegible] Pittsburgh [illegible] the sand of which [illegible] has been [illegible] from the start. Glass [illegible] the largest producer is the Pittsburgh Plate Glass Company.

The company is also a leading [illegible] the largest [illegible] chemicals.

It was in Pittsburgh in [illegible] 1869 [illegible] that George Westinghouse [illegible] to [illegible] railroad brakes [illegible] Because the [illegible] required [illegible] Westinghouse [illegible] there ever since.

Family Day at Westinghouse

On [illegible] 1948 [illegible] Family Day at the [illegible] plant of the Westinghouse Electric Corporation in East Pittsburgh. With operations closed for the day, the more than 23,000 [illegible] to see where [illegible] workers [illegible] presented with [illegible] workers who had [illegible]

[illegible] in the [illegible] Mr. [illegible] Mrs. [illegible]

Pittsburgh's "Mr. Average" Recounts a Historic Event

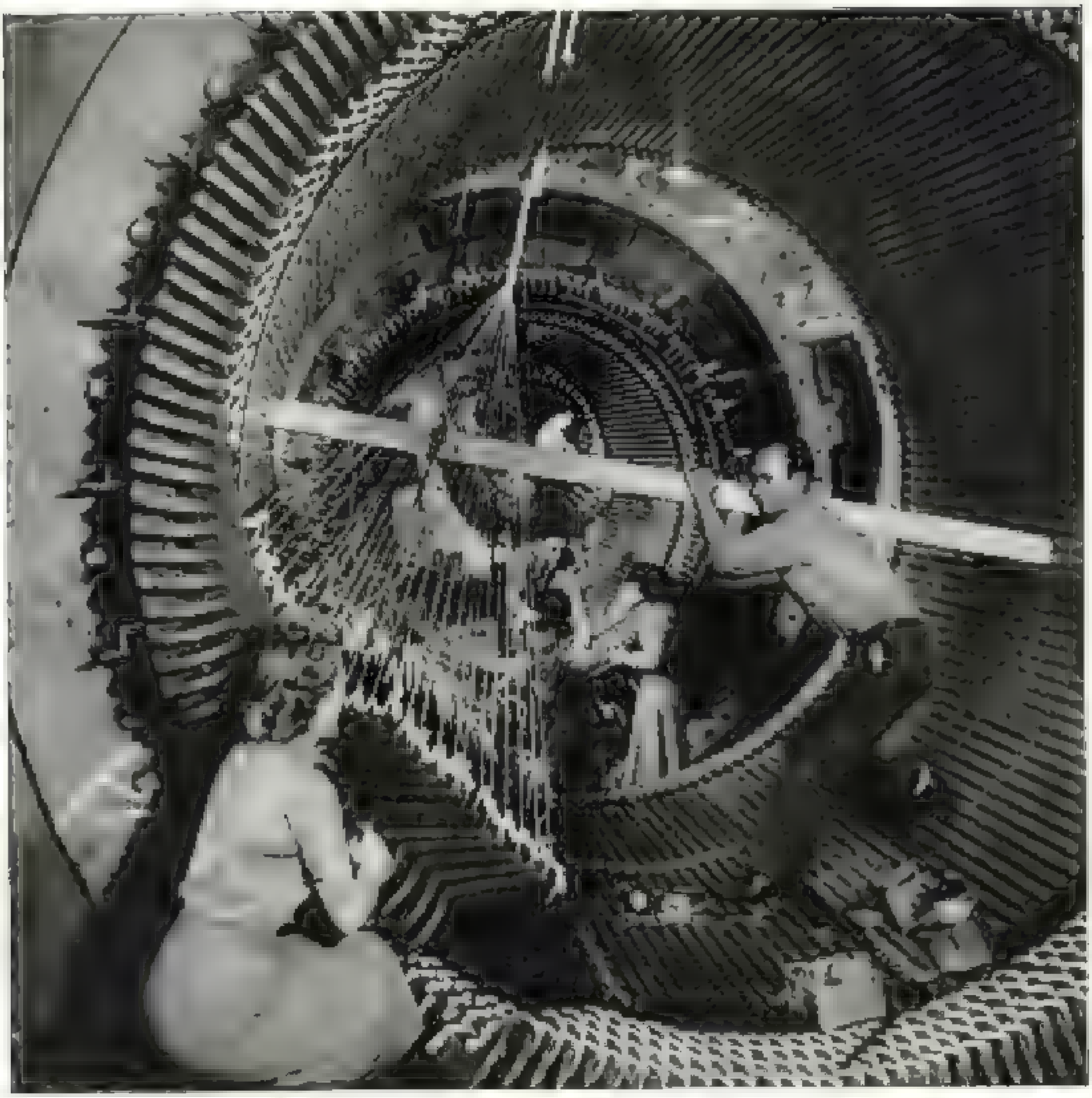
[illegible]

Heinz's '57 Varieties' Are Sold in Several Languages

[illegible]

Franckers Twinning in Tuscee Heat Give Barlands Tilt Strong Finish

[illegible]



Giant Condensers, Custom-built in East Pittsburgh, Help Light the World

In the Westinghouse Electric Corporation plant, workmen assemble a [illegible] [illegible] Westinghouse [illegible] [illegible] [illegible] Westinghouse [illegible]

From this vast plant come 15,000 carloads of heavy electrical equipment, much of it to be erected, or shipped each year. Among the products are motors, [illegible] and [illegible] electrical equipment for [illegible] [illegible], and railroad [illegible].

Most impressive are the huge [illegible] generators [illegible] the electric power industry [illegible] generators [illegible] have been built for Grand Coulee, the TVA, the City of Los Angeles, Brazil, Ireland, and Peru, and for many power companies in the United States.

A single one of these generators will supply light and power for scores of thousands of homes. The mammoth building where they were being constructed seemed to me one of the most vitally important places in the whole world, as very few are the concerns which make this type of apparatus.

In a tiny make-shift shack on the roof of one of these buildings commercial radio had its beginnings on November 2, 1920, when station KDKA received reports by telephone of the Harding-Cox election from a Pittsburgh newspaper and made the first regularly scheduled broadcast to about 500 listeners, mostly amateur wireless operators.

One of the comparatively few large indus-

ties within the city limits of Pittsburgh itself is the H. J. Heinz Company, so long known for its trademark, "57 Varieties" (page 132).

Its beautifully equipped and attractive buildings, to be greatly expanded this year, are open to visitors; in the summer season a [illegible] period [illegible] year [illegible] Time one of the most interesting features was the almost complete mechanization of spaghetti making, formerly a hand operation.

As a young man of 25 in 1869, the first H. J. Heinz grew horse-radish and packaged and distributed it in near-by Sharpsburg; the business has remained in Pittsburgh ever since. The founder was followed by his son Howard, and 32-year-old H. J. Heinz II took over in 1941.

This concern is the largest maker of ketchup in the world, and this is a very large user of tomatoes. Since tomatoes are vulnerable to [illegible] commercial markets for its supply, as it does with more hardy vegetables, but develops its own strains, supplies seedling plants to thousands of farmers, contracts to buy their entire crop when harvested, and sends out experts during the growing season to help the farmers if blight or other injury is threatened.

Heinz is the second largest maker of canned soups and one of the four largest makers of baby food. Although there literally are from 120 to 127 varieties, not the labled "57," the chief products, besides ketchup, soup, and baby foods, are baked beans, pickles, spaghetti, and condiments.

A Center of Research

It is unlikely that many people outside of Pittsburgh realize that continuous research as well as production is one of the city's primary functions. Laboratories, no less than mills, line its river valleys, and it has a tremendous concentration of technical societies.

As everyone knows, the electrical industry is based upon research,* and for almost 60 years hundreds of scientific projects in the Westinghouse Research Laboratories in East Pittsburgh have been translated into processes and products that make life pleasanter and easier.

In the company's first rented building in Garrison Alley, Pittsburgh, three rooms on the second floor were set aside as an "electrical laboratory." In fact, the company would not have been organized at all if it had not been for William Stanley's research on alternating currents on behalf of George Westinghouse.

For many years the cheapness and abundance of coal discouraged intensive chemical research, but more recently Pittsburgh has become the headquarters for coal research in America. This is being carried on not only by government agencies, universities, and research institutions, but by the joint action of a number of coal and oil companies.

Of particular interest to the general public are the pilot plants for turning coal into gasoline. At present the outcome is still uncertain, but gasoline can be made from coal.

One of the great laboratories which I visited in the Pittsburgh district was that of the Gulf Research & Development Company at Harmarville, on the Allegheny River (page 122). Here more than 1,000 persons are employed and the work of more than an additional 500 in the field is overseen—that is, of exploratory parties in all parts of the world.

Research is especially necessary to oil companies because processes are fast outmoded. Such a company is dependent upon the designers of equipment—that is, of engines. The too sudden replacement of the present type of gasoline automobile engine by another type, such as the turbine, might upset the economics of the oil refinery industry by requiring a different type of fuel.

At the Harmarville laboratories every fuel and lubricant produced from petroleum was being tested, including even the smallest specialties, such as watch oil. Here also I saw experiments in the gasification of coal.

Maps and the Search for Oil

I had not previously thought of such a laboratory as being one of the country's largest and most meticulous map-making centers, but the collection of data concerning the location of oil by means of magnetic, gravitational, and seismological measurements must all be put down on maps, and immediately! Such maps do not take years to make; they are turned out every week (page 143).

The air-borne magnetometer was devised by scientists of this company. The principle was first applied to submarine detection during World War II, and after the conflict it was applied geologically.

It [illegible] air-borne crew can map 450 profile miles daily, as compared with 50 miles a day by a surface magnetometer crew in fairly open country. And of course it can readily survey jungle, swamp, desert, and other areas heretofore so inaccessible as to make exploration economically prohibitive.

These measurements of the earth's magnetic

* "The Fire of Heaven (Electricity)," by Albert [illegible], NATIONAL GEOGRAPHIC MAGAZINE, No[illegible]

Luxury and Gold Splendor Surrounds Pittsburgh Students Delving into Oriental Lore

[illegible]

[illegible] especially by the use of the seismograph.

One of the most marvelous of scores of gadgets and devices I saw at these laboratories was an electric analog of an oil field. By means of this device actual conditions in a particular oil field can be simulated, and its length of life as well as the best methods of developing it can be ascertained.

But the average layman will probably find the Mellon Institute the most interesting of all research laboratories in the Pittsburgh district (page 119).

This is one of the most important scientific institutions in America, and is housed in an unusual and beautiful building in the Civic Center of Pittsburgh itself.

Three of the nine floors are below ground level, and there are four interior courts for natural lighting. In addition to extensive machine shops and library, office, lecture, and social rooms, there are 370 separate rooms for scientific and investigational work.

"Pillars of Science"

Approximately 80 separate and independent research projects, or "industrial fellowships," were carried on in a recent year by 575 senior and junior scientists. The building has the largest monolithic column installation in the world; each of the 62 columns surrounding the building weighs 60 tons—veritable "pillars of science."

As early as 1909, Andrew W. Mellon, Secretary of the Treasury under three Presidents, and his brother, Richard B. Mellon, became aware of the gap then existing between [illegible] and industry in this country, as compared with their profitable partnership in Europe. As a result, they founded the Institute in 1913.

It is the oldest and probably still the largest industrial laboratory in the United States in which joint facilities are used cooperatively to improve existing products and processes and create new uses for a great variety of different industrial companies, large and small. Thousands of such companies have been served.

The early idea was to aid small industries but a number of these have grown into very large ones because of the Institute's work. In fact, it has actually created whole industries, as well as provided presidents, vice presidents, and research directors for others.

One homely illustration is that of the Chicago concern which produces seamless tubing from viscose cellulose to be used for frankfurter casings, "cotton shirts on wieners," the result of ten years of Mellon Institute research.

One of the largest chemical manufacturers in the United States is so engaged largely because of the Institute's contribution.

Among the enormous number and variety of projects on which the Institute has worked are protective coatings for storing hot water, roof ventilators, new methods for measuring stream pollution, production of new food flavors, industrial application of soybeans, chemicals from corn, the behavior and properties of thread, dry-cleaning technology, new fire-fighting agents, new pan coatings for the baking industry to eliminate the greasing of pans, new materials for life preservers, investigation of eye injuries from chemicals, and steel mill and coal mine wastes.

In a recent year, among the new fellowships started were those in candy technology, grinding wheels, and orthopedic appliances. The Institute supports departments of research in pure chemistry and physical chemistry.

Far too many visitors to Pittsburgh see only the Triangle and the industrial districts along the rivers. They do not realize that the Civic Center, of which the Mellon Institute is a part, contains a most striking architectural grouping and is one of the most impressive centers of its kind to be found anywhere.

It is not accurately named, for the county and city buildings are in the Triangle, more than two miles away beyond a barrier of hills. In reality, the Civic Center consists of an unusual concentration of universities, libraries, laboratories, art galleries, music halls, auditoriums, hospitals, memorials, athletic fields, and a natural-history museum.

It is a cultural, educational, research, art, musical, and athletic center overlooking Schenley Park.

In Forbes Field more than a million and a half people watch professional football and baseball each year.

A Cathedral of Learning

Dominating the Civic Center, and the oldest landmark of the entire area, is a 42-story skyscraper, the Cathedral of Learning of the University of Pittsburgh. This is a building which people cannot avoid looking up to, both literally and figuratively.

It was erected very deliberately, not only to suggest by its height and reach the spiritual values which underlie university education but to give lift to the whole city, to serve as a symbol of the birth of civic spirit.

The building broadens out noticeably toward its base, and most of the hundreds of classrooms are in the first five stories. Above are libraries, and still higher the offices.

Entering from the ground level, you find

Songs of Pittsburgh's Beloved Stephen Foster Still Rise Above the Roar of Industry

In the Stephen Foster Memorial, a [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] Foster died in New York in 1864 [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] "Dear Friends and Gentle Hearts."

housed in a vast Gothic Commons Room (pages 171 and 175). Here thousands of students of every age, sect, and social origin gather as in a sort of indoor campus every hour of the day until night, [illegible] sitting, chatting, studying, smoking and [illegible] between lectures and classes.

From the corridor surrounding the Commons Room there open 19 nationality classrooms, each a gift from a different national group living in the Pittsburgh district and each designed by foreign architects and [illegible]. An Early American Room is on the third floor.

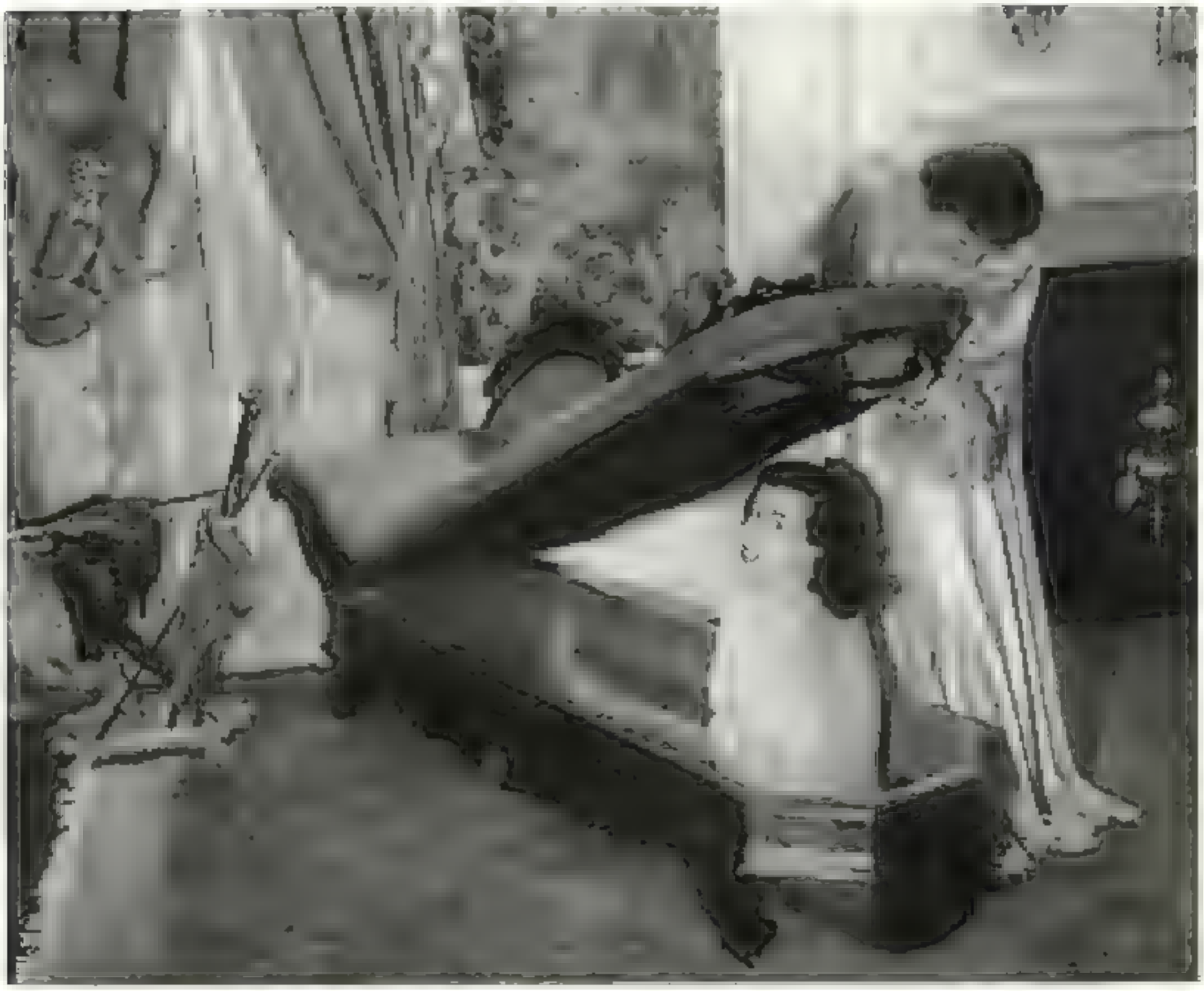
These rooms were completed from 1938 to 1948 and the university is [illegible]. Visitors are welcomed and are shown [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the most generous cultural [illegible] of a people.

Political differences are never forgotten. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of living statesmen.

Today [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] many of them [illegible] [illegible] [illegible]. The idea for the rooms was [illegible] [illegible] [illegible] [illegible].

A [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] Pittsburgh district [illegible] [illegible] [illegible] [illegible] American, the [illegible] was set up to [illegible] to preserve in the university rooms the best of their own culture.

At the University, classrooms never stop [illegible] [illegible] [illegible] good will [illegible] and tolerance among the student groups [illegible] different national origins. Students [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]



Lift the Seat and Presto! Milady's Sofa Becomes a Bathtub

[illegible]

[illegible] had regular classes in session. Not too unfortunately, a professor was lecturing to a large class in medieval history in the Greek room; an Army officer had a small seminar in military [illegible] in the Chinese room (page 146).

At least this University [illegible] to the Pittsburgh Academy [illegible] was not a more important [illegible] Chancellor John G. Bowman began to [illegible] large [illegible] in 1921. [illegible]

[illegible] come from the Pittsburgh district but most of them [illegible] there. In other words, the University supplies the [illegible] with much of their technical training [illegible].

During a single semester of the 1947-48 academic year, [illegible] students [illegible] in different [illegible] Saturday classes. The Carnegie Institute of Technology [illegible] most students.

The department of the University [illegible] does not draw its students from the Pittsburgh district alone, and whose graduates do not necessarily remain there. The Research Bureau [illegible] founded in 1919 [illegible] of retailing [illegible] the country. The Field-Lange [illegible] the support and [illegible] its [illegible] in other [illegible].

Memorial to a Song Writer

Near [illegible] of [illegible], and designed to harmonize with [illegible] much smaller building, the Stephen Collins Foster Memorial

(page 158). This contains an auditorium in constant use by musical organizations and also the outstanding collection of source material of the famous song writer, whose work is probably the most typically American expression of any composer.

Although Foster began to write songs in earnest in Cincinnati, and there decided to abandon a business career to become a professional composer, he was born in Pittsburgh, lived there most of his life, and wrote most of his great songs there.

Among other treasures in the Memorial is Foster's book of original manuscripts, with more than 200 pages of first drafts of published songs, unpublished verses, inscriptions, and cartoons, all in his handwriting. Here one may see the evolution of his most famous songs, including *Old Folks at Home*.

One of the most pathetic Foster relics to be seen is the pocketbook and its contents which he left at the time of his tragic death in Bellevue Hospital in New York City in 1864. All it contained was 38 cents in money and a small scrap of paper bearing five pencilled words. The words were probably to be used as the title or theme of a song which he did not live to write: "Dear Friends and Gentle Hearts."

The erection of the Foster Memorial in 1937 was greatly aided by Josiah Kirby Lilly, an Indianapolis drug manufacturer, to whose activity as a collector of Fosteriana much of the recent revival of interest in Foster is due. Probably one reason Mr. Lilly decided to place his collection in Pittsburgh was that singing has always been an important part of our civic life, especially among the Welsh, German and Italian elements.

To increase his income as a song writer, Foster wrote for the colored minstrel shows. He was not a southerner, but as a little boy he went to a Negro church with his nurse, and the Pittsburgh river front, where Negroes were a colorful element and where many travelers to and from the South were to be seen, helped give him the flavor for his so-called plantation songs.

Benefactions of Andrew Carnegie

Two other notable groups of buildings in the Civic Center are those founded and endowed by the little Scottish-born iron and steel master, Andrew Carnegie. They are the Carnegie Institute, which combines in a most unusual arrangement a large public library, a museum, an art gallery, and a music hall, all in one building (pages 127 and 128); and in a separate group of buildings the Carnegie Institute of Technology.

As early as 1881 Carnegie offered a library to Pittsburgh; the unique idea of adding a technical school, museum, music hall, and art gallery came later. As a young boy, Carnegie had access to the private library of Col. James Anderson in Allegheny, now the North Side, and his benefactions seem to have been the natural result of his great interest in reading and books.

He may well have looked forward through the dust and smoke of the vast industry which he helped create to see the need of cultural opportunities in the later development of the city.

Beginning in 1896 and continuing, with omissions during World War I and until 1940, when the conditions of World War II made shipments impossible, the Carnegie Institute carried on the famous International Exhibition of Contemporary Paintings. At its peak, as many as 515 paintings were shown, and one exhibition included canvases from 21 nations.

Carnegie Exhibition To Be Resumed

With the aid of a $225,000 Mellon grant, the Exhibition will be resumed in 1950.

At the Carnegie Institute of Technology no fewer than five of the important fine arts, painting, sculpture, architecture, acting, and music, are taught under one roof (pages 131, 142, and opposite).

In addition, there is a women's college and an engineering school. Many engineers and scientists in the industrial laboratories of Pittsburgh take evening courses at "Tech," some have students take as long as 10 to 15 years to get a degree.

It is, however, is not primarily a city university like "Tech," as it draws students from many parts of the country and from foreign lands rather than almost exclusively from the Pittsburgh district.

The city was settled originally by Scotch Irish, and their descendants, with their strong leanings toward Presbyterianism, have remained dominant elements in its life. In fact, Pittsburgh is one of the great world centers of the Presbyterian denomination, although in Allegheny County there are 1,273 churches in all, of practically every faith.

In the Triangle there are three historic churches—the First Presbyterian and Trinity [illegible] sites and in whose yards are buried Indians [illegible] German Evangelical Protestant Church. The land for all three congregations was given by the heirs of William Penn.

But it is not until we reach and pass beyond the Civic Center that we really enter the

[illegible] Of all the [illegible] the most notable is the East Liberty Presbyterian Church, [illegible] at a cost of nearly $4,000,000 between 1932 and 1935 by Richard B. Mellon and his wife, both of whom are buried in it.

This [illegible] is the fifth in a series of churches on the site since the congregation was organized in 1819. Except for its spire, [illegible] of the building is underground [illegible]. There are more than 50 Sunday school rooms and a [illegible] and [illegible] is equipped with a dating [illegible] 500.

Halfway between the great sanctuary and the small chapel and close to each is a perfectly equipped brides' room. No [illegible] is omitted, including an ironing board [illegible] into the wall. A two-way communication system between the brides' room and the organist informs the bride when to begin the processional.

Curtain Going Up! She Does Her Share Backstage

[illegible]

Pittsburgh is indeed fortunate to have its religious, educational, cultural, and recreational facilities. In addition there are [illegible] Playhouse [illegible] theater [illegible] center, and many musical and art organizations. To [illegible] rich and poor, and to those of every national origin, such opportunities are available.

What [illegible] materials there are [illegible] aesthetic values [illegible] people. [illegible]

For a long time Pittsburgh was so busy becoming a mighty [illegible] center that it [illegible] little [illegible] traffic congestion, inadequate housing [illegible]. In other words, it did little to make itself a [illegible] place to live.

The Conquest of Smoke and Grime

[illegible] conservative, Pittsburghers long [illegible] smoke [illegible] inevitable. They even defended it as a sign of prosperity.

[illegible]

But this is no longer the attitude. Pitts-

A Roller Coaster? No, It's a Carnegie Tech Idea for a Better Billboard

[illegible]

burgh is now determined to [illegible] down [illegible] as well as an industrial city. Smoke [illegible] tion has become [illegible] of the whole [illegible] improve- ment (page [illegible]).

[illegible] of rivers and hills [illegible] and [illegible] has been [illegible] in making them [illegible] Improvement [illegible] but [illegible] rivers [illegible] these valleys.

Pittsburgh has [illegible] engineering [illegible] technical engineering [illegible]

Pittsburgh [illegible] always [illegible] great philan- thropic tradition, partly [illegible] early settlers. Local

there are [illegible] charitable [illegible] in the city [illegible] those [illegible] New York. The [illegible] Foundation [illegible] established by the Mellon family, but the [illegible] and [illegible] are substantial.

Andrew Carnegie gave extensively to Pitts- burgh's [illegible] and [illegible] Henry [illegible] and Charles M. Schwab left the city. Most wealthy families, however, including the Mellons, [illegible] Harkisons and H[illegible] [illegible]. The "elder" Mellons Andrew W. and [illegible] Richard B. gave away large [illegible] personal contact with [illegible]

Richard K. Mellon (page [illegible]), R. B.'s [illegible] now [illegible] a very different [illegible] Mellon Square, [illegible]

Airplanes Find New Oil Sources for Pittsburgh, Girls Mark Them on a Huge Field Chart

At Gulf Research & Development Company [illegible]

[illegible] Dick Mellon's [illegible] Avenue in New York City [illegible] Pittsburgh people [illegible] Mellon [illegible] School of Industrial Administration [illegible]

United Action for Civic Improvement

[illegible]

city has been taking in its own history thanks to the Buhl Foundation, the University of Pittsburgh, the Historical Society of Western Pennsylvania, and other organizations.

Years ago it was the youthful George Washington who fixed the location of the city by reporting to Governor Dinwiddie of Virginia that the "land in the fork"—that is, the apex of the Triangle—should be fortified. Washington had been sent to warn the French to stay away from this region, and he shared in British defeats which followed, the worst under General Braddock.

But finally in November 25, 1758, the victorious Gen. John Forbes, with Washington as one of his lieutenants, marched into the smoldering ruins of Fort Duquesne, which the French had built on the remains of a former British fort and had now abandoned.

City Named for William Pitt

Forbes wrote, "I have taken the freedom of giving your name to Fort Duquesne," thus naming the future city after England's great statesman, William Pitt. Being a Scotsman, Forbes used the "h," as in Edinburgh. Although there are some 20 Pittsburgs in the United States, there is only one Pittsburgh.

On this site the British built Fort Pitt, a very extensive fortification, the best-designed and the most important frontier fort in the West.

It was never used against the French, because Forbes's victory at Pittsburgh and finally Wolfe's at Quebec the following year ended the imperial designs of France upon the Ohio and Mississippi Valleys.

But Fort Pitt was for a long period a protection to what was perhaps the greatest natural gateway to the West. It fought off Indian attacks and was also an important western outpost during the Revolution.

By 1790 Fort Pitt was no longer needed. It fell into ruins, city streets were extended through it, private owners took up the property, and early houses in Pittsburgh were said to have been built of bricks from the fort.

Though covered up by the city for a century and a half, not all the foundations were destroyed; recent archeological excavations have disclosed extensive remains. In addition, one entire redoubt, that built by Col. Henry Bouquet, has remained intact, the reason being that it was used for many years as a dwelling, and, indeed, had another large house attached to it.

Ultimately this section of the city became a slum and later a forlorn district of railroad sidings and waste uses.

Eventually Mrs. Mary E. Schenley, one of Pittsburgh's first benefactors on the grand scale, inherited the redoubt and in 1894 gave it to the Pittsburgh Chapter of the Daughters of the American Revolution, the first chapter to apply for a charter in that organization.

Block House Reminder of Frontier

At once the attached dwelling and the tumble-down tenements which covered the ground around the redoubt were removed and the name changed from Redoubt to the Block House.

One of the great railroad systems planned to have and raze the Block House. It was saved only by the spirit and determination of the DAR chapter, especially of one of its members, Mrs. Samuel Ammon, who spent months in Harrisburg fighting the railroad.

Today the Block House is in an isolated spot, almost hidden and surrounded by elevated railroad tracks. Yet many patriotic visitors find their way there.

It is a little building built of brick, five-sided, and with two floors. It has a squared oak log with loopholes for rifle fire on each floor.

It is a simple but authentic and vivid reminder of one of the most important and romantic chapters in colonial history, a chapter of struggles which went far in changing the fate of a continent.

The east- or west-bound motorist sees in Pittsburgh a traffic bottleneck. But this is temporary, because the Penn-Lincoln Parkway is under construction from the terminus of the great Pennsylvania Turnpike at Irwin, Pennsylvania, to the point of the Triangle. It will tunnel through the Pittsburgh hills, drop to the bank of the Monongahela, cross on a new bridge near the Point, and thus start the traveler on his way into West Virginia and Ohio.

Already the State has acquired virtually all of the land to make a 50-acre Point Park (page 130). But no one need wait for these improvements to visit the Block House, the only remaining vestige of frontier Pittsburgh.

INDEX FOR JANUARY–JUNE, 1949, VOLUME READY

Index for Volume XCV, January–June, 1949, of the National Geographic Magazine, will be mailed upon request to members who bind their copies as works of reference.

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To carry out the purposes for which it was founded nearly one hundred years, the National Geographic Society publishes the Magazine monthly [illegible]

Articles and photographs are desired. For material [illegible]

In addition to the editorial and pictorial contents [illegible] the Society has [illegible] than [illegible] expeditions [illegible] of field work [illegible]

[illegible] the Society [illegible] the southwestern United States [illegible] the Aztecs [illegible] the Cliff Dwellers [illegible] three hundred years.

In Mexico, the Society and the Smithsonian Institution January 19, 1933, discovered the earliest work on man in the Americas [illegible] which we have a date. The stela [illegible] in Maya characters with a date which means November 6, 292 B. C. (Spinden Correlation). It [illegible] culture previously unknown.

[illegible] by the National Geographic Society and the U. S. Army Air Corps, the world's largest balloon, *Explorer II*, [illegible] expected to give valuable records of cosmic rays [illegible] Lieut. Albert W. Stevens and Capt. Orvil A. Anderson [illegible] instruments and obtained results of extraordinary value.

The National Geographic Society–U. S. Army Air Force Expedition [illegible] from a camp in northern Peru, photographed and observed the total eclipse of 1947. This was the seventh expedition of The Society to observe a total eclipse of the sun.

The Society contributed to the Dr. William Beebe deep-sea explorations off the Bermuda, during which a world record dive of 3,028 feet was [illegible]

The Society gave $[illegible], and an additional $75,000 was given by individual members [illegible] Government when the congressional appropriation [illegible] for the purchase [illegible] of the giant sequoia trees in the Giant Forest of Sequoia National Park in California [illegible] the American people.

One of the world's largest [illegible] and plant systems [illegible] Society and the Alexander Hamilton Institute, 1914.

Commander Six flight coupe

Studebaker's the stand-out

in savings that count and style that sings

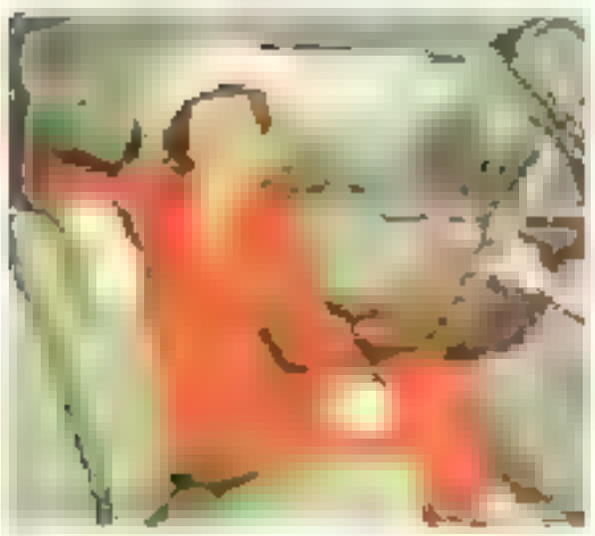
MAKE Studebaker your new-car buy word—and you're sure to find yourself money ahead!

[illegible] away, thanks to Studebaker trim, sleek contours.

Studebaker's flight-streamed designing bars out [illegible] ing of gasoline.

And what a relaxed, road-hugging ride you get! [illegible]

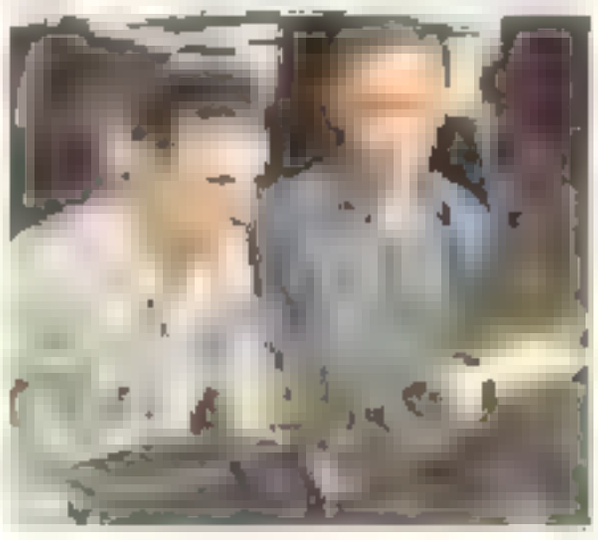
Stop in at a showroom—see why a Studebaker buying wave is sweeping the country. There's a Studebaker just right for your needs and means.



Studebaker's fabulously fine interiors are rich with distinc- [illegible]

Studebakers breeze by the gas pumps for days and miles at a [illegible]

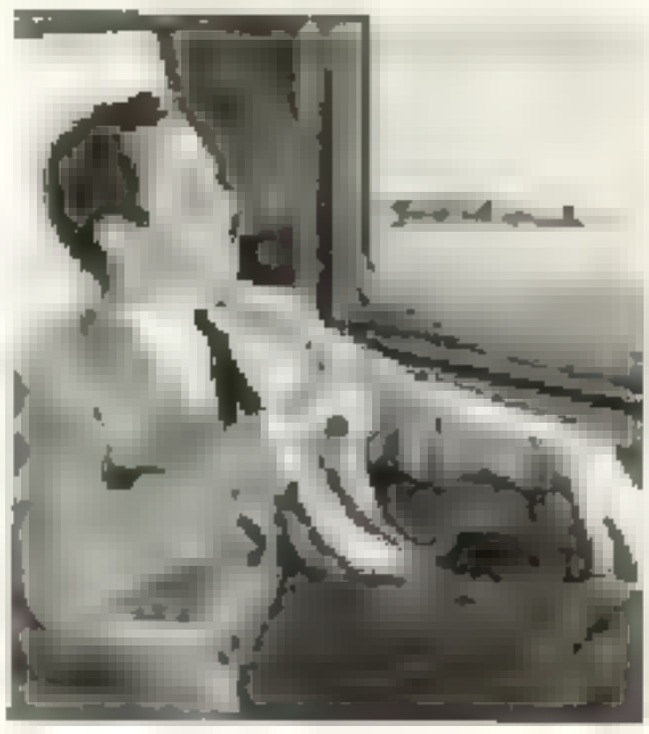
Brakes almost never need servicing in a Studebaker [illegible]



Built by father-and-son teams [illegible]

How to turn miles into smiles...

You smile with satisfaction [illegible]



You smile contentedly [illegible]

You smile with pleasure [illegible]

You smile with anticipation [illegible]

You smile happily as you arrive in the [illegible]

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What is your sight worth ...$25...$35...$50?

[illegible] would hardly hesitate to spend [illegible] to make certain sound [illegible] properly [illegible] to see well. But actually, in most cases [illegible] low. The fee you pay [illegible]

- The professional and technical services you receive.
- Your own special eyesight prescription.
- The quality and style of glasses or contact prescription calls for.

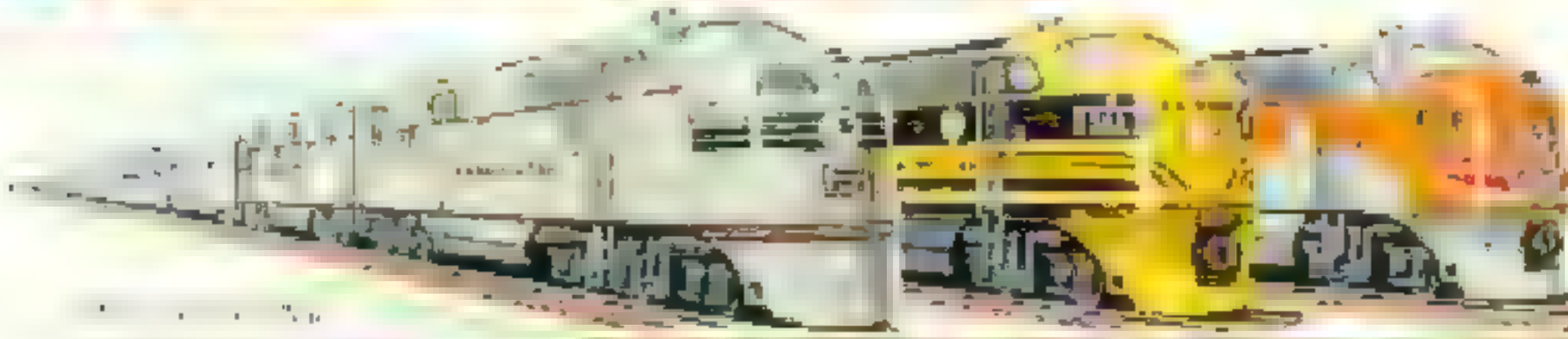
The [illegible] are widely available and [illegible] the medical, to low [illegible] only a few pennies [illegible] life of the average prescription.

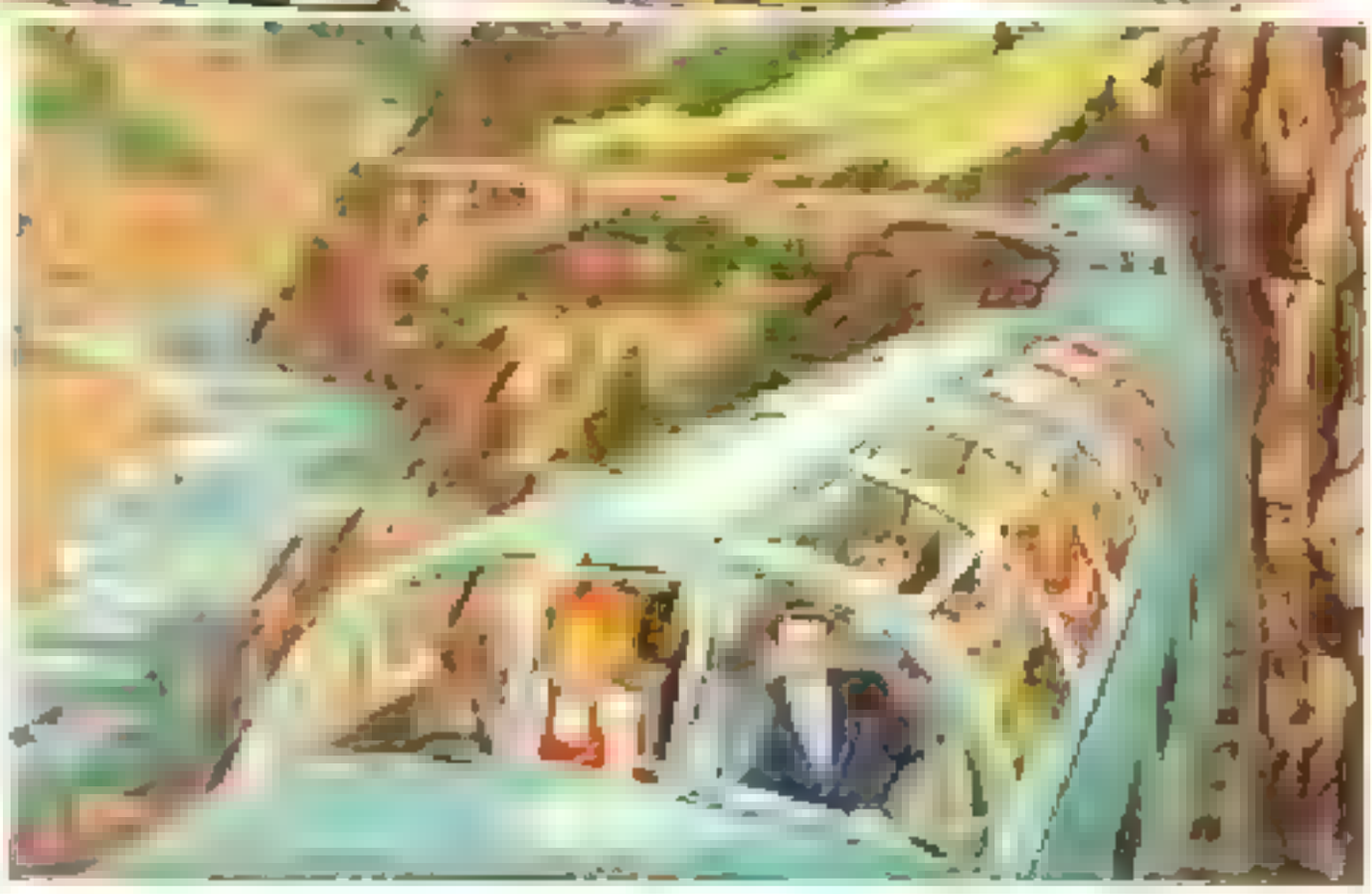
American Optical

FITTING

RE EVALUATION

SERVICING





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[illegible] stainless steel train in 1934. New [illegible] world's largest [illegible] stainless steel [illegible]

[illegible] Budd [illegible] New York City [illegible] Board of Transportation. In years of [illegible] developments which [illegible] Budd [illegible] operations [illegible] more efficient [illegible] service. The Budd Company, Philadelphia, Detroit

[illegible] weight, [illegible] built the first lightweight,

Budd

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You will enjoy one in Pennsylvania's resorts—renowned for fun and relaxation. [illegible] square miles. A vacation [illegible] with business [illegible] *plus these extra features.* [illegible] historic shrines • [illegible] highways • [illegible] • Quaint villages • Recreational areas • State forests and parks • Natural wonders including unique underground caves. *Pennsylvania hostelries are operating [illegible] to expand and improve accommodations.*

[illegible]

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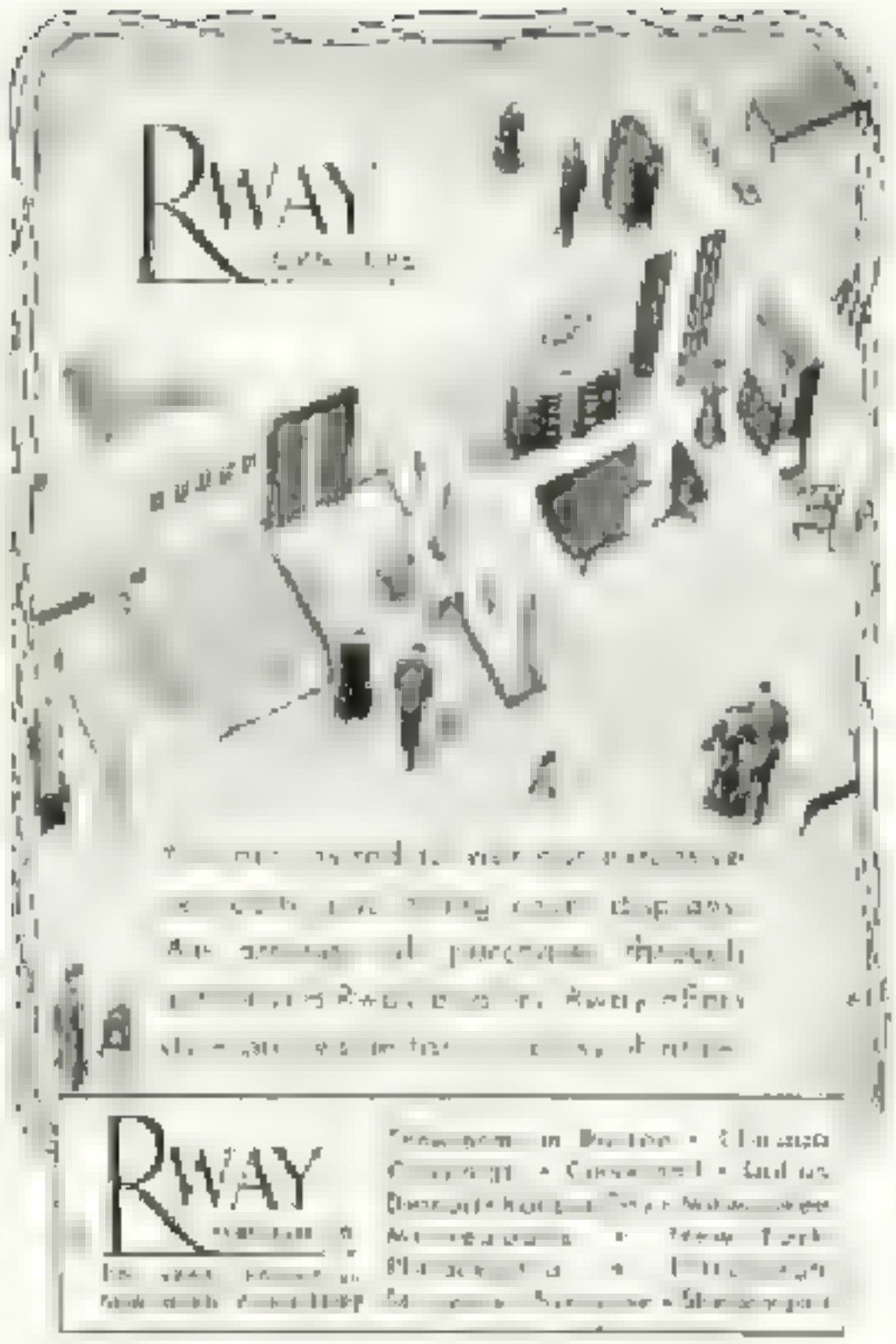
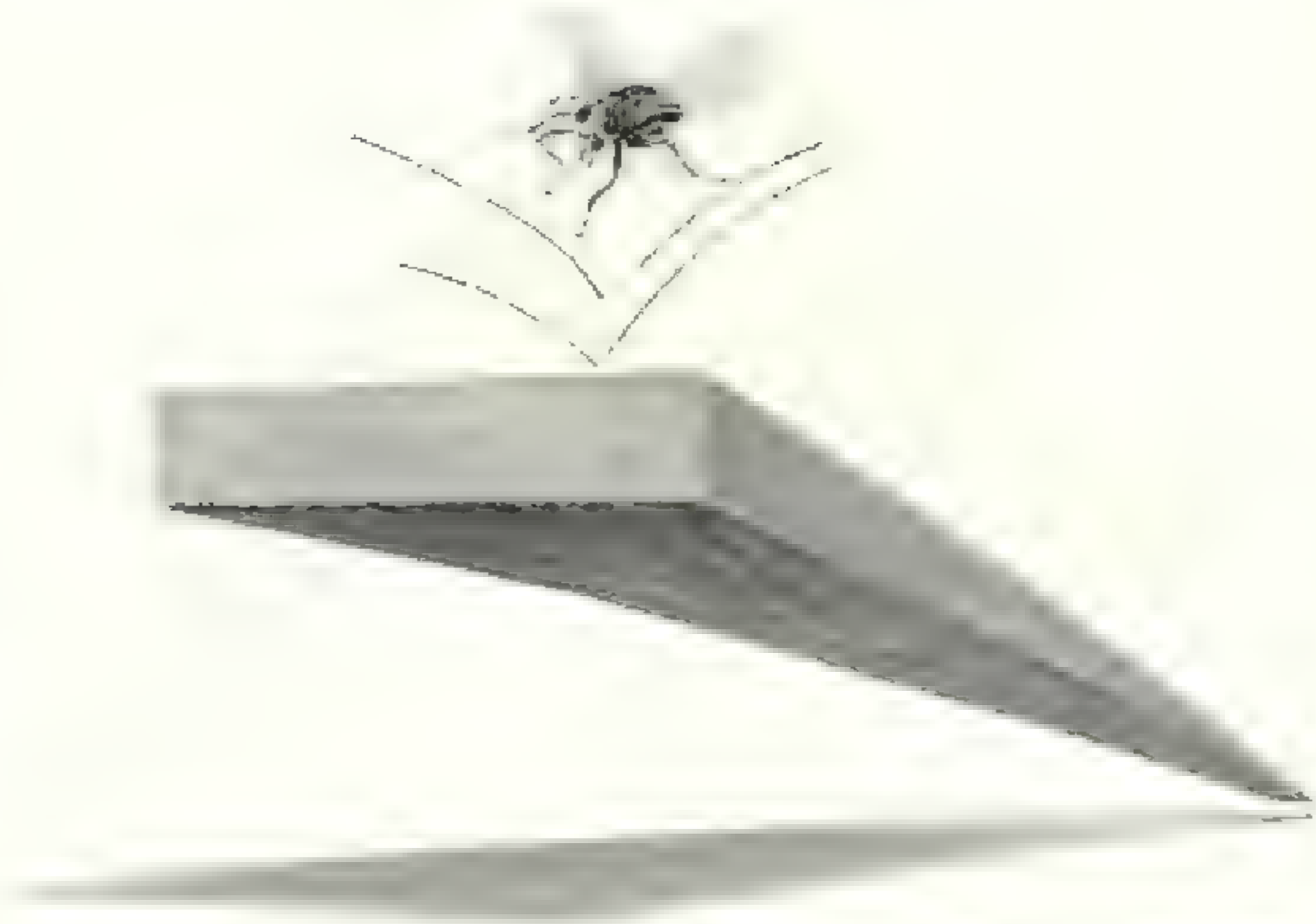
[illegible] make [illegible] surf bathing



Makes every view a clear close-up view

[illegible] detail sharply, clearly. Before you buy any [illegible] Bausch & Lomb [illegible] which really [illegible] for [illegible]

[illegible]



Supersensitive electron tube developed by RCA, makes possible more accurate measurement of minute vibrations.

Can a housefly make a board bounce?

Surprising though it seems, a fly—when it lands on a board—causes distinct vibrations. They can actually be detected by a remarkable, and supersensitive new RCA electron tube.

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Scientists predict many practical uses for this *electron transducer*. Airplane designers can hitch it to engines or whirling propellers and locate vibrations which might lead to trouble. Oil men can use it to measure the sound waves from explosions with which they scout for oil.

And your smooth-running automobile of the future may be an even better car when the facts gathered by RCA's new tube are put to work.

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The electronic transducer, first of its kind, is one of many research achievements pioneered at RCA Laboratories. [illegible] engineering adds *value beyond price* to any product or service of RCA and RCA Victor.

[illegible] on radio, [illegible] and electronics [illegible] at RCA Exhibition Hall, 30 Rockefeller Plaza, N. Y. Admission is free. Radio Corporation of America, Radio City, New York.

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NO TELL-TALE BUTTON TO SHOW!

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General Manager

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Frank W. Boyton, President

S.R.O.

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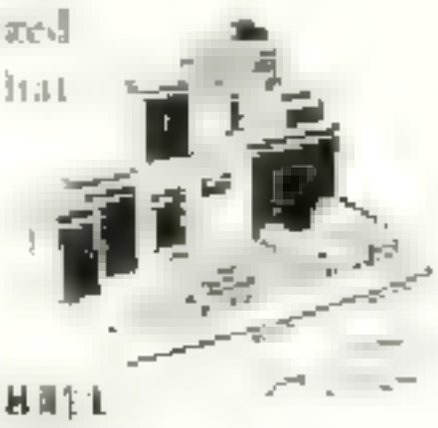

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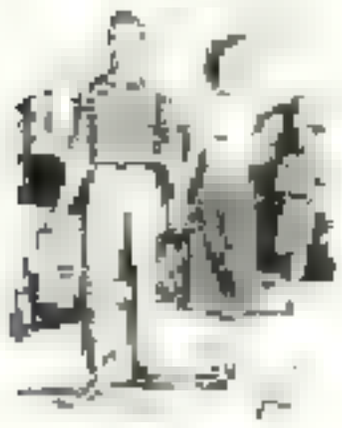
Free Vacation Guide

TO NEW YORK STATE

The most complete ever published by any state! 196 pages packed with full-color photographs and valuable information about all the fifteen vacation regions in the Empire State.



1. [illegible]

2. [illegible]

3. [illegible]

4. [illegible]

5. [illegible]

6. [illegible]

7. [illegible]

8. Lovers of sun and sand flock to [illegible] for swimming and deep sea fishing.

9. You'll actually see [illegible] in New York's famous [illegible]

10. [illegible]

11. There are [illegible] ideal for fishing, [illegible]

12. [illegible]

13. [illegible]

14. [illegible]

15. [illegible]

THOMAS E. DEWEY
Governor

HAROLD KELLER
Commissioner of Commerce

New York State Department of Commerce
[illegible]

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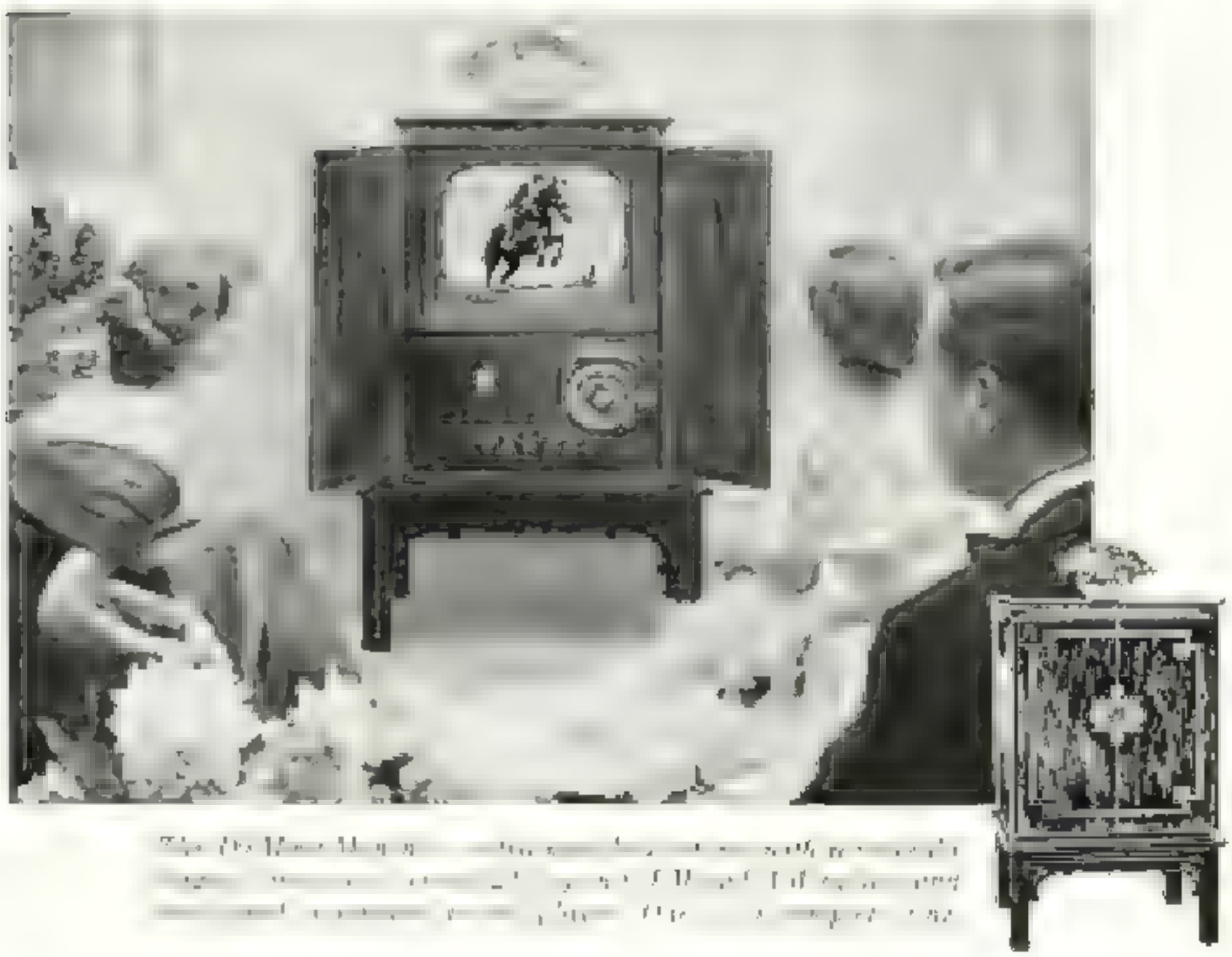
YOU'LL HAVE A STANDARD OF COMPARISON

See television [illegible] at its finest . . . on a DuMont.

See the clear, brilliant, steady picture on the [illegible] screen. Listen to its rich, full-range tones. [illegible]

for then you will know the quality of [illegible]

[illegible]



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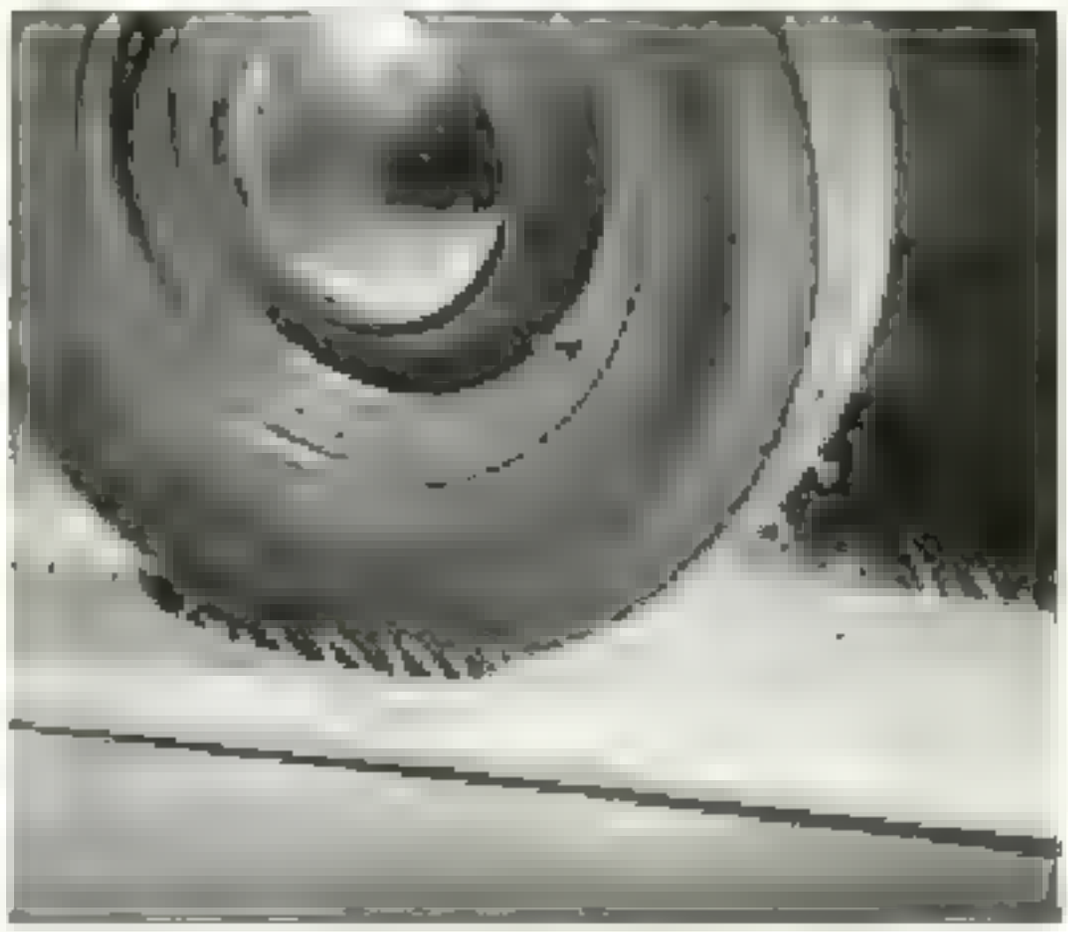

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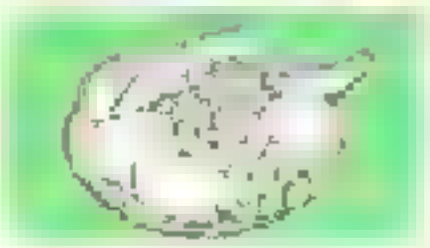
TASTY SUMMER FOODS for GOOD HEALTH

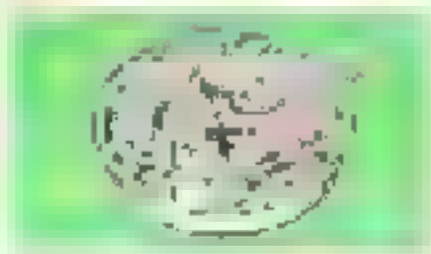
Summer or winter we require a well-balanced diet—one which includes an adequate supply of proteins, carbohydrates, vitamins and minerals. These essentials for sound nutrition may be found in three groups of foods. *Energy foods*, such as cereals and bread, butter and fats, and sweets, provide fuel for all the operations. *Building foods*, including meat, fish, eggs, and milk, help to take care of growth and repair of body tissues. *Protective foods*, like vegetables, which group of [illegible] are especially rich in vitamins and minerals and help safeguard health.

Within each group there is a wide choice of foods which permits the selection of menus suited to the season of the year. Cheese and egg dishes, for example, may be particularly inviting on hot days, while heavy, fatty meats seem more appropriate in the winter. In addition, fresh vegetables and fruits, which are more abundant in summer, may often be substituted for winter staples.



Digestive upsets are more likely to occur in summer than at other times of the year. A light [illegible] including fruits, will be less apt to overburden the digestive system than a heavy one.

One good hot meal a day in summer is recommended by nutrition experts. During the war, U. S. Army tests in the tropics showed that it was easier for overheated men to digest hot food than cold.



Raw vegetables, served [illegible] are often more nutritious than cooked, for the vitamin content of cabbage, carrots and other vegetables is higher when raw. They may also make summer meals more appealing.

In summer the body may [illegible] $1\frac{1}{2}$ quarts of water a day. This liquid must be replaced, for it helps to assimilate food and regulate body temperature. So, one should drink plenty of liquids in warm weather.

Authorities say that eating the right foods at the right intervals usually [illegible] a better lot of health at all ages and may contribute [illegible] More facts about healthful eating may be found in Met [illegible] booklet, 7DN, "Three Meals a Day." Mail this coupon for a free copy.

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[illegible] —[illegible]

[illegible] nature He [illegible] And he's also [illegible]

The name of [illegible] [illegible] is not a [illegible] robot can do in making your [illegible]

[illegible] a decent current should [illegible]

[illegible]

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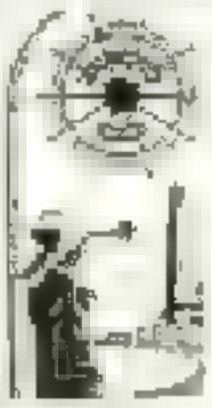

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